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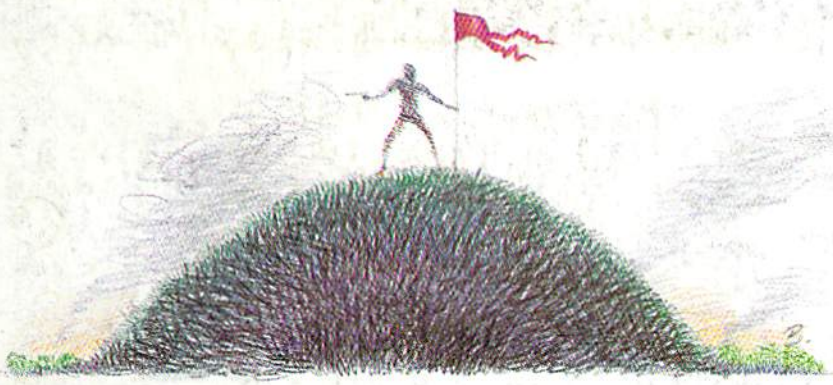

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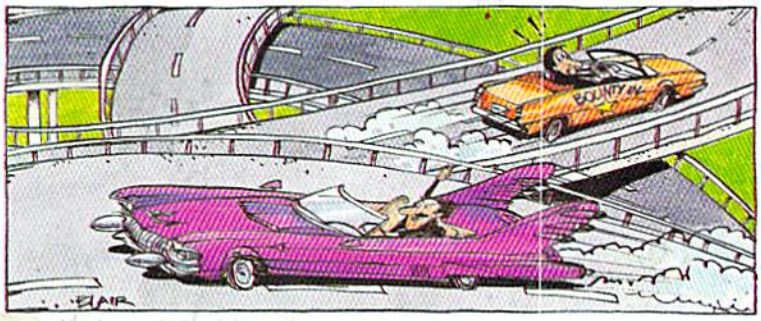

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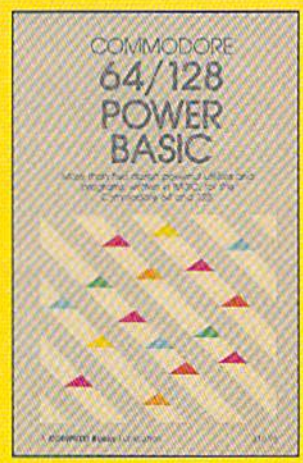

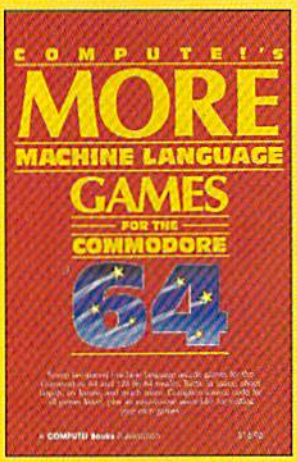

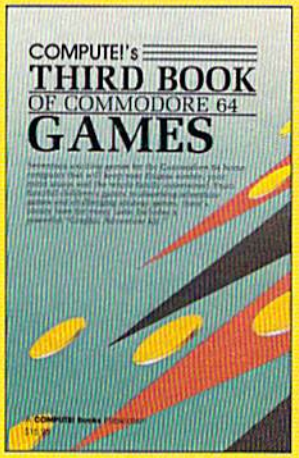

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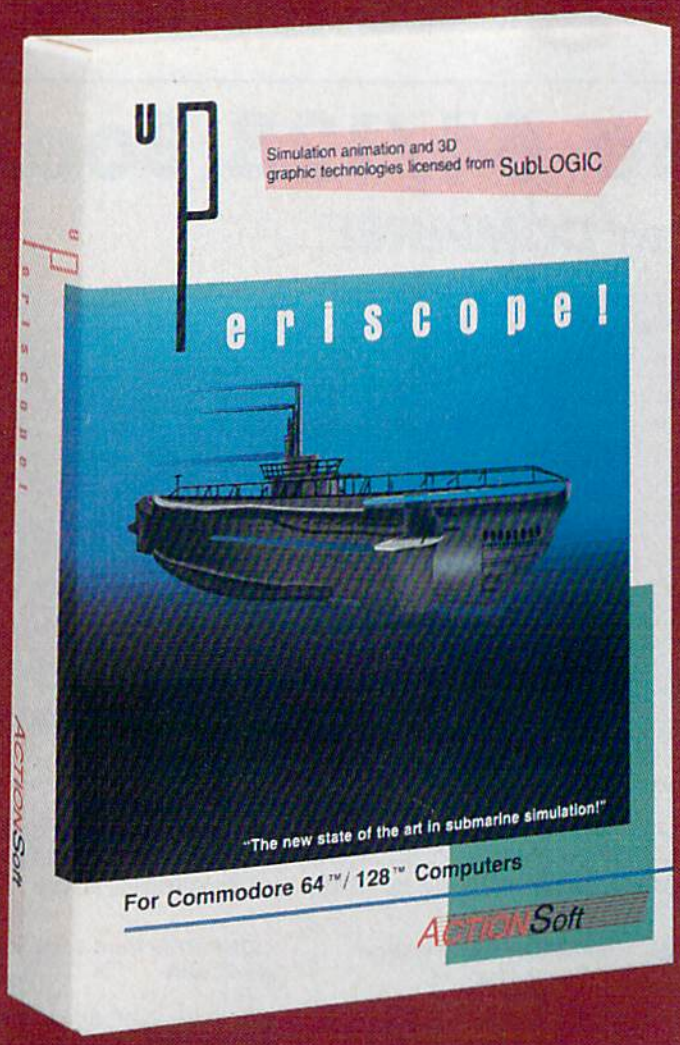
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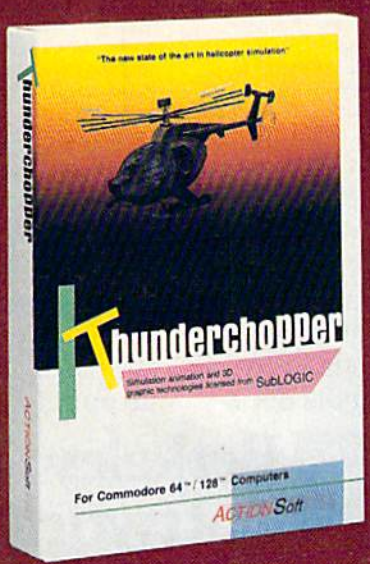
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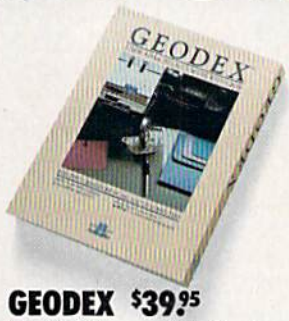

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*=General, **64**=Commodore 64, **+4**=Plus/4, **16**=Commodore 16, **128**=Commodore 128

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editor's notes

Many personal computers use fans to keep them cool. This is a clue to the intensity of the activity inside: The more that's going on, and the faster it's going on, the hotter the machine gets. After all, there are no fans inside TVs or VCRs or other electronic appliances, essentially because these other appliances aren't as smart as computers. There are far fewer electronic switches, the switches operate at lower speeds, and they are much less densely packed.

Perhaps you've seen pictures of the world's most sophisticated computer, the Cray. It looks like one of those circular sofas found in hotel lobbys, but the bulk of what you see is its massive refrigeration unit. The computer's circuits are so dense, so much is happening in such a small space, that without cooling it would soon melt.

A computer is made up of countless little switches, called gates. Right now the main barrier to building more powerful computers is the speed at which these gates can be turned on and off. Since every gate delays the information slightly as it travels through the machine, there is a direct relationship between gate speed and the resulting speed and power of a computer.

After all, a computer thinks by sending information around inside itself until the data has been processed in some predetermined fashion. If you want the computer to add 2 + 2, it sends the first 2 into an arithmetic section; the operation (addition) is fetched and registered from the gates that control the processor; the second 2 is then sent; the operation is performed; and the result is sent to other gates in a storage area. If you increase the speed of these gates, the computer does more, faster.

The electrons which carry the information within a computer travel at pretty much the same speeds no matter what conducting materials are used. It wouldn't help much, for example, to substitute silver for copper wire. The *semi*-conducting material does, however, matter. Today's gates are made of silicon, but there has been some interest in replacing silicon with a different semiconducting material, gallium arsenide. Although more expensive, this material switches somewhat faster than silicon. However, this research may now be moot. Recent developments suggest that a breakthrough in switching speed is upon us. You'll likely hear a great deal about *superconductivity* in the coming months; it has many applications beyond the world of computing. But discoveries in this field may well lead to supercomputers far beyond present capacities.

Since 1911, scientists have known that certain metals, when cooled to nearly absolute zero (−459.4° Fahrenheit), suddenly change into superconductors—their crystalline structure abruptly becomes far more orderly. Electricity flows through them with no resistance and therefore with virtually no loss of power or buildup of heat. Unfortunately, this spectacular effect worked only if you continually bathed the metal in rare and expensive liquid helium to maintain that unimaginably low temperature.

Then, last year, using new ceramic compounds, researchers were able to achieve superconductivity at −424°. This was a great improvement because cheaper cooling via liquid hydrogen became possible. In the past few months, however, records have been broken right and left. A compound was developed that went superconductive at −320°, which could be cooled by liquid nitrogen. Then another was found at −240° and another at only −57°. As this issue was going to press, a New York company, Energy Conservation Devices, announced the discovery of a material which superconducts at an astonishing 9° F. At these high temperatures, superconduction becomes inexpensive and practical. You could do it in your home freezer.

For years IBM had been pouring hundreds of millions of dollars into this technology without much success. In 1983, the giant computer firm halted further research and, as a result, interest in superconductivity cooled in labs worldwide. But now money is pouring in and physicists everywhere are mixing exotic compounds in a race to find the thing that goes superconductive at room temperature.

Superconducting materials make extremely fast electronic switches. Ordinary silicon gates switch in 10–20 nanoseconds (a nanosecond is one-thousandth of a microsecond). But superconductive gates switch as quickly as .05 picosecond (a picosecond is one-millionth of a microsecond, a very short amount of time). Superconducting gates thus run millions of times faster than their silicon counterparts.

If you make a ring of superconducting material and send electric current into it, the current flows around the ring indefinitely. No resistance also means very low power requirements and no heat. Superconducting compounds promise great advances in such diverse applications as extremely sensitive medical diagnosis equipment, ultra high-speed magnetic trains, far more efficient electric power, high-resolution radar, and many other breakthroughs not yet conceived. The technology may also make possible the construction of inexpensively powered supercomputers: desktop machines far, far more powerful than the Cray.

Richard Mansfield
Editorial Director

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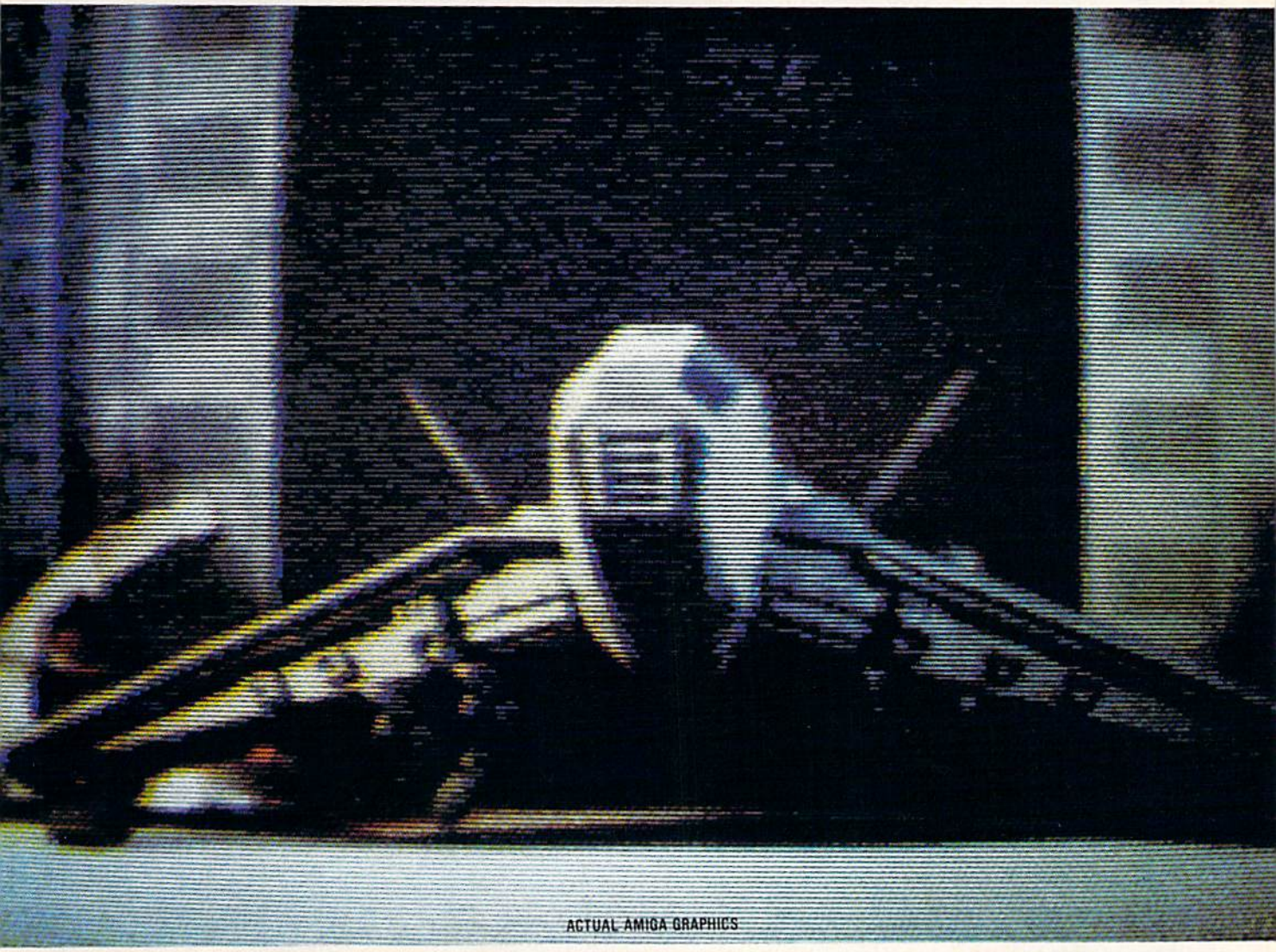

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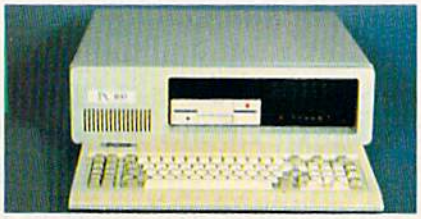

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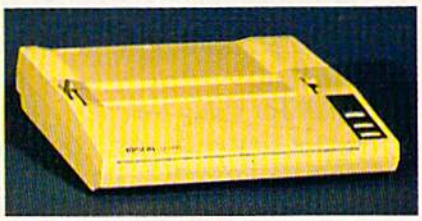

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The Rules For Using Numbers

I have tried for several weeks to find an answer to my question by my own research, but with no luck. It's about to drive me up the wall. The attached program printout doesn't make sense to me. What do the numbers in the DATA statements mean? I know there are 73 data elements and that line 10 POKEs them into consecutive bytes of memory starting at 49152, but what do the numbers do? If you were writing a program, how would you know what numbers to put in to do what you wanted?

Bob Wagner

The data you question starts out like this:

```
1 DATA 169,254,45,14,220,141,14
```

DATA statements can hold many types of information. Those numbers might be sports scores, stock prices, or shoe sizes.

In this case the data holds a machine language program. Later in the program a SYS 49152 occurs, and 49152 is where these numbers are POKEd at the beginning of the program. The SYS command transfers control from BASIC to a machine language routine. To find out what these DATA statements mean, you must disassemble *them. To do this you need a table of* opcodes *for the 6502 microprocessor. First look up 169 in the table. You find that 169 is an LDA immediate instruction and that it takes a one-byte argument. That means that the next byte is the operand for the LDA instruction. So the actual instruction is LDA #254. Following this process again, we find that the next number represents AND, and it takes a two-byte address, which in this case is 14+220*256; so, we have AND 56334. Of course, you have to know machine language to understand what the routine does and how it does it. Disassembling is a powerful tool for learning how other programmers do the things they do. So how does anyone know what numbers to put into the DATA statements? Most machine language programmers use an assembler to write their programs. The assembler takes source code and converts it into bytes in memory. Later, these bytes are copied from memory into DATA statements.*

A Light At The End Of The File

I am writing a program to read a sequential file on disk and print it on a printer. The program below works fine except when it comes to the last data item in the file, which it keeps printing forever:

```
10 OPEN 2, 8, 2, "IMP.DATES,S,R"
20 OPEN 3, 4
30 INPUT#2, A$
40 PRINT#3, A$
50 IF ST=0 THEN 30
60 CLOSE2: CLOSE3
```

The problem is the variable ST in line 50; it never equals 64. Could you please let me know if there is a way to fix this?

Yousef Eisa Ebrahim

The variable ST tells you the STatus of the last serial bus input/output operation. Like TI and TI$, it's a reserved variable which is automatically updated by the computer.

Your program is almost correct, but you're not checking ST soon enough. After the INPUT# in line 30, ST equals 64 if the program has reached the end of the file. Testing the value of ST is one way to find the end of a disk file.

But the PRINT# in line 40 is also a serial bus input/output operation. It resets ST to 0, indicating that the printer didn't return any error codes. To fix the program, record the value of ST in another variable after the INPUT# from the file, but before the PRINT# occurs. For your example, add a line `35 Q=ST`. *Then change line 50 to* `IF Q=0 THEN 30`. *When the last piece of data is read from the file, the program will end.*

Hiding Data From The User

Is there a way to prevent people from listing a BASIC program? I'm writing an adventure game and want to hide the listing.

Troy Pladson

There are several tricks ranging from simple to complicated that prevent a BASIC program from being listed. One is to put a colon, a REM, and a shifted L *at the end of a line (this works on the 64 but not the 128). The line will list, but the* L *causes an error message to print, and the listing stops. You can also add to a line a REM and two quotation marks (then delete the second one, so you're not in quote mode); then add RVS ON and a series of reversed* Ts, *which will act like DELete characters.*

The problem with these schemes is that no matter how clever you are with protecting your program from being listed, there are usually a large number of people who can figure out what you did and get around it. For example, a technique that prevents you from listing to the screen doesn't always work on printer listings.

If you've stored in DATA statements the messages, room descriptions, treasures, traps, and other miscellany, it's possible that someone would list the program to figure it out instead of learning by playing the game. There are several ways to foil nosy users. You could put the information in a sequential file instead of in DATA statements. Another possibility is to encode the information by using ASC and CHR$ to convert characters to ASCII numbers and turn them into codes that aren't easily read. You could also put in some false paths, like a room containing huge amounts of gold, but no doors that lead to it. Someone who read through the listing might spend a lot of time trying to find the imaginary treasure trove.

---

128 Percussion

I'm writing a synthesizer program, and I'd like to know how to create sounds on my 128 like bass drums, snares, and cymbals. The percussion sounds software designers come up with sound mainly like hand claps.

Jesse Jack

The SID (Sound Interface Device) chip found in the 128 can make very sophisticated sounds. The 128's BASIC 7.0 supports the SID chip with six music commands: VOL, SOUND, ENVELOPE, TEMPO, PLAY, and FILTER. To get rhythm sounds such as the snare drum, bass drum, and cymbal, only a few steps are necessary.

Here's a program for the 128 that de-

fines some percussion sounds and plays a rhythm track:

```
10 TEMPO 32:ENVELOPE 1,0,4,0,3
   ,3:ENVELOPE 2,0,05,2,0,3:EN
   VELOPE 3,0,0,0,3,3:FILTER 9
   36,0,1,0
20 PLAY "V1X0T1U15V3X0T3U15V2X
   1T2U15"
30 PLAY "MV206HCV300HCV206QCMV
   300QCMV206HCV106HCV206HC"
40 GOTO 30
```

For more about how the SID chip works, see "Exploring the SID Chip" elsewhere in this issue.

Replacement Supplies For The 1520

I loved the tip in the May issue for turning the Commodore 1520 printer/plotter from device 6 into device 4. I dug mine out of the closet and in ten minutes had it working. But I was out of paper. I've looked everywhere, but have had no luck. Can you help?

Harold Wallace

Commodore no longer makes the 1520 printer/plotter or supplies for it, but there's an alternate source. Radio Shack once sold a printer/plotter which was very similar to the 1520. The pens and paper for the Radio Shack plotter will fit the 1520. A local store will either have them in stock or be able to order them for you.

BSAVE For Variables?

I've found that with my 128, saving sprite data or other information directly from memory to binary files with BSAVE is faster than saving variables to data files. Is it possible to BSAVE variables? How would you do it?

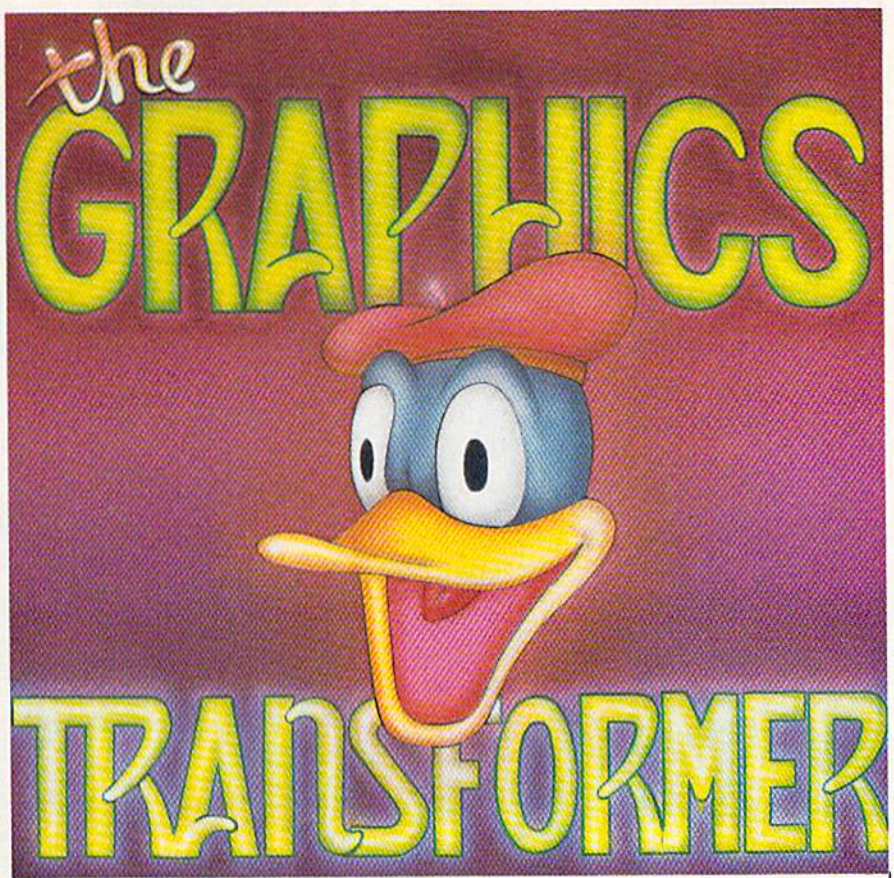
Michael Petracek

You're right, writing to a sequential file is slower than BSAVEing a portion of memory. Here's why: A program that writes variable values to a file (using PRINT#) sends ASCII characters. For example, if the variable X holds the number −513.68, the command PRINT#1, X would send a minus sign, the ASCII character for 5 (CHR$(53)), the ASCII character for 1, the ASCII character for 3, and so on. When the program reads such a file, it has to convert the individual characters into the five bytes that represent a floating-point number. Also, a program that reads a file byte by byte has some delays between the characters, partly because it's checking for the last character in the variable value.

Theoretically, it's possible to BSAVE variables from bank 1 and later BLOAD them into memory, but you'd have to understand how variables are stored in memory. Simple variables such as A$, QQ, or Y1% (string, floating-point, or integer variables that are not arrays) use two bytes for the variable name and five for the variable descriptor, which is either a binary representation of a number or (for strings) more information about the variable. With numeric variables (floating-point and integer), the binary value is self-contained in the five bytes immediately following the two bytes for the name. String variables use one of the five bytes to hold the string length and use two more as a pointer to high memory where the actual string is located (these strings move around from time to time, in the process called garbage collection*). On the 128—but not on the 64—the strings in high memory are immediately followed by a two-byte pointer that points back to the descriptor in low memory.*

What this means is that you can't just BSAVE the string information; you'd have to BSAVE at least two portions of memory, plus you'd probably have to sacrifice all other strings, and you'd have to save a large amount of garbage (unless you forced garbage collection with the FRE(1) function). You'd need to save the zero-page string pointers, too. You'd have to use several BSAVEs, which would take more time than it's worth.

So strings are out of the question, but numeric variables could be BSAVEd. To find the address of a particular variable, use the POINTER function, which returns a pointer to the first of the five bytes containing the value, just past the two bytes of the variable name. You'd have to BSAVE the byte from the address returned by POINTER, plus the following four bytes. The best application for BSAVEing



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would not be simple variables (only five bytes each), but arrays. Floating-point arrays occupy five bytes per element, while integer arrays occupy only two per element. Remember to include the zeroth entry in your calculations. DIM A%(50) creates an array of 51 elements when you include A%(0). If you're interested in looking around in memory, the built-in machine language monitor is very useful.

To BSAVE an array, you'd first have to calculate the amount of memory it occupies. Then, without using any new (previously undefined) variables, ask the POINTER function for the address of the initial element and BSAVE the array from bank 1. To return the array to memory, DIM the array first and then find its address. Using that location (which is in bank 1), BLOAD the file from disk.

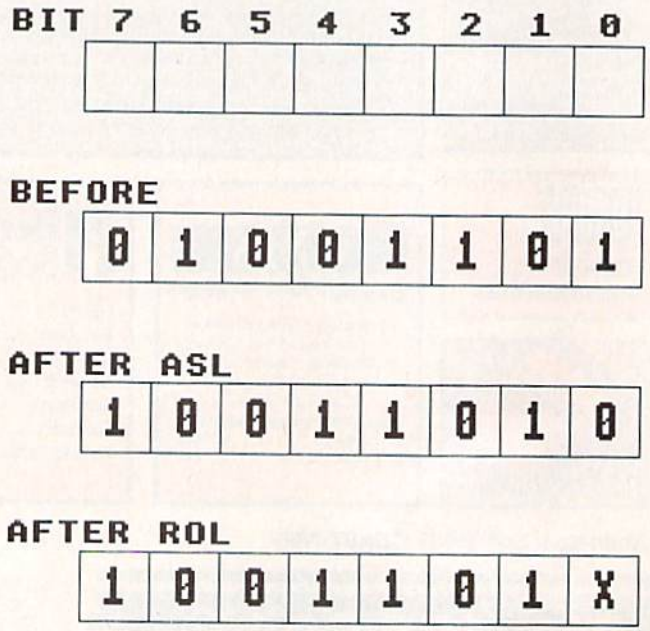
Carry On, Carry Off

I have a few questions about 6502 machine language. What is the difference between the instructions ASL and ROL? LSR and ROR? Does the carry bit have to be set via SEC to subtract (SBC)?

William Grinolds

All three answers involve some aspect of the carry bit. The carry flag is a single bit in the status register that can be either up or down (on or off). When it's set (on), it's equal to 1. When it's clear (off), it's a 0.

The machine language instructions ASL and ROL shift all eight bits of a byte to the left, as illustrated below. Bit 0 moves to bit 1, 1 moves to 2, and so on. Bit 7 falls out of the byte and moves into the carry flag. In the example, since bit 7 holds a 0, the carry will be clear after the ASL or ROL.



The difference between ASL and ROL is that ASL always moves a 0 into bit 0. ROL moves the previous value from the carry flag into bit 0 (marked as X in the ROL example above). The binary number 01001101 above is the same as decimal 77. After the ASL, the number is 10011010 (decimal 154). After the ROL, it's either 10011010 or 10011011 (154 or 155), depending on the status of the carry flag before the ROL operation. Note that ASL is equivalent to multiplying by 2. To multiply a two-byte (or larger) number by 2, you'd ASL the low byte and then ROL the high byte, because you want to shift bit 7 of the low byte into bit 0 of the higher byte. If you perform nine ROLs, you end up with the same value you started with. After eight ASLs, you always get a zero (binary 00000000).

The LSR and ROR instructions are similar to ASL and ROL, except that they move bits to the right. In the case of ROR, the carry bit moves into position 7 and bit 0 moves into the carry flag. With LSR, a zero always moves into bit 7. LSR is the same as dividing by 2, with the remainder of 0 or 1 left in the carry flag.

When you subtract, the SBC (SuBtract with Carry) instruction can operate in two ways. If you're subtracting single-byte quantities, you need to set the carry (SEC) before using SBC. The calculation 20 − 5 should give you an answer of 15, and it does if the carry is set. But if the carry is clear, the answer is 14, because there's a borrow of 1. When you add, you can have bits that carry to the next column; when you subtract, you can have bits that are borrowed from the next column. For multiple-byte quantities, use SEC before you subtract one low byte from the other. After that, the carry takes care of itself, based on whether a borrow is necessary.

Plus/4 And 16 Graphics Compatibility With The 128

I own a Commodore 16 and would like to remind you that the 128 has many commands that are the same as the 16. In your April issue, you printed an article "The Versatile CIRCLE." I haven't tried the programs yet, but they look like they would run on the 16.

Henry Hanecak

Good suggestion. We tried the CIRCLE programs on a Commodore 16, and they work fine if you make one change. At the beginning of each program, the COLOR command sets the hi-res colors. You'll have to adjust the values after COLOR for the Plus/4 or 16.

As you've noted, most of the 128's graphics commands work on the Plus/4 and 16, so articles about 128 graphics will usually apply to these computers as well. One problem you might encounter with a Commodore 16 (but not with the Plus/4) is that the hi-res screen uses 9K of memory, which doesn't leave much space for BASIC programs.

Scratching Comma Files

When I list the directories of several of my disks, I find files whose names are ",". I have no idea how they got on the disk and haven't been able to scratch them. Is there any way to remove them short of copying all the valid files to another disk?

C. Robert Budd

Comma files are usually written by a program that gives you the option of saving some information to disk. If you press RETURN at the input prompt without typing a filename, the program adds ,S,W to the non-existent filename and then tries to open a file called ,S,W. To prevent this from happening, you should check the length of filenames entered by the user before opening a file. The length should be at least one character.

You can't scratch a comma file directly because commas can function as separators (for deleting more than one file at the same time) in the scratch command. But you can get rid of it by using the question-mark wildcard. Try this:

```
OPEN 15,8,15: PRINT#15,"S0:?":
 CLOSE15
```

This line scratches all one-character filenames, including the comma file. If you have important one-letter files with names like A or Z, rename them temporarily before using the question-mark technique. After scratching the one-character files, you can then rename the other files back to their original one-letter names.

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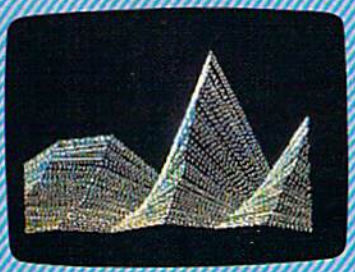

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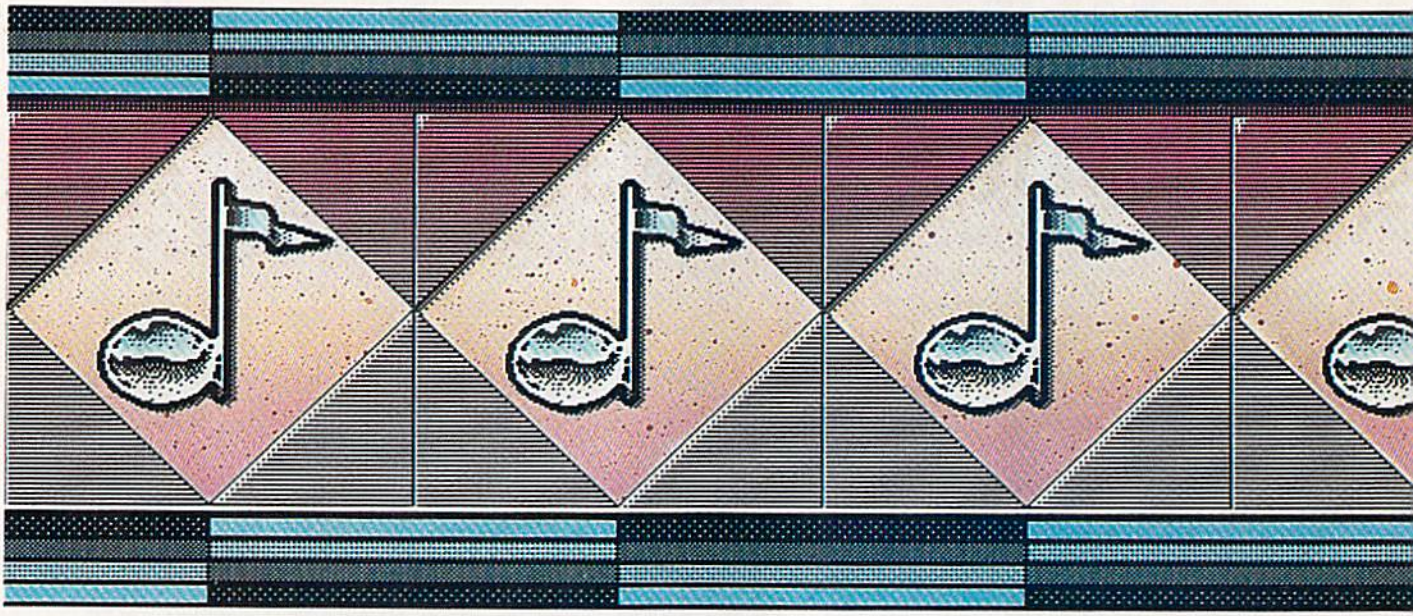


Commodore's 64 And 128: **Marvelous Music Machines**

Selby Bateman, Associate Publisher

Five years after its introduction, the Commodore 64 can still astonish the uninitiated with its music and sound effects. And the Commodore 128, thanks to the same remarkable Sound Interface Device (SID) chip, carries on the tradition. At the same time, rapid advances in electronic music and digital technology are making the 64 and 128 even more versatile, powerful, and entertaining music machines.

Music—and musicians—will never be the same again.

"The computer-music revolution is here," says Larry Ullman, software products specialist for RolandCorp US, a company that develops and markets musical instruments and software for a wide range of computers.

"This is just an absolutely amazing opportunity to expose people to the creativity of music who might never otherwise have experienced it," adds Al Hospers, vice president of Dr. T's Music Software, another software company specializing in computer music.

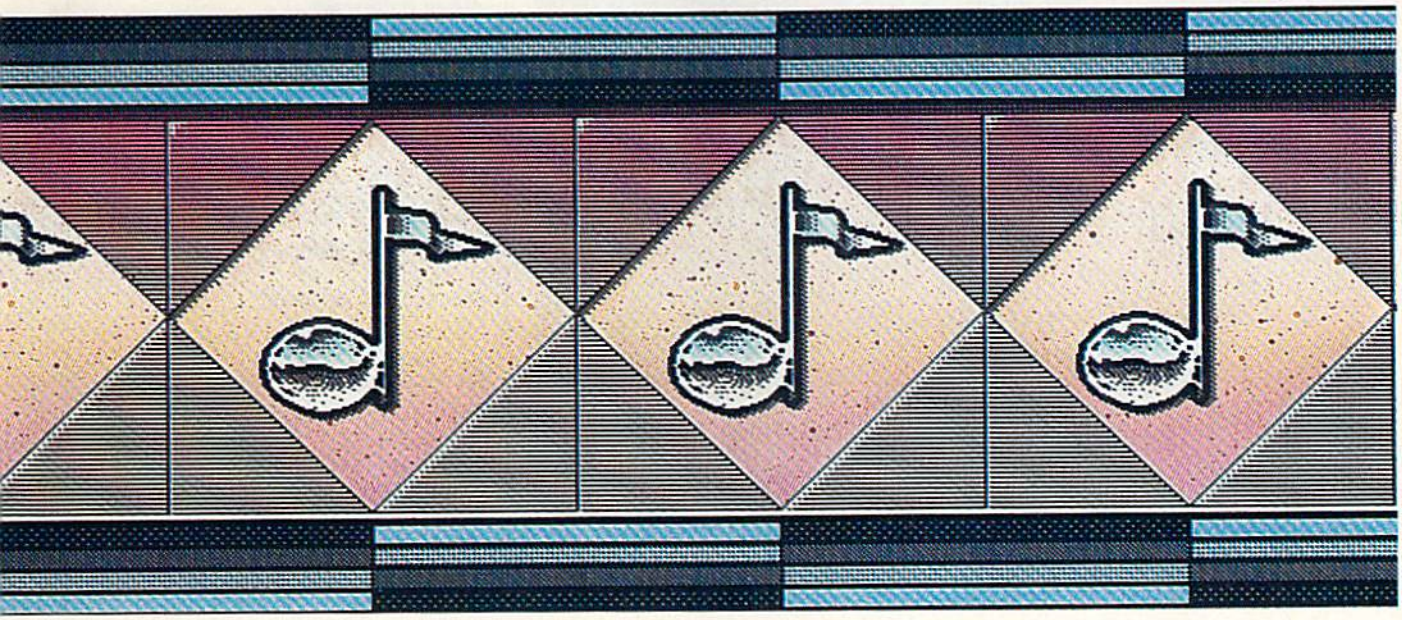
"We're opening the ears and eyes of musicians out there," says Daniel Kantor, merchandising manager for Wenger Corporation's Music Learning Division, a company heavily involved in music education and software. "With this technology, you're learning that you can do whatever you want."

Echoing that enthusiasm are musicians, music teachers, composers, and even nonmusicians, all of whom are experiencing firsthand one of the most fundamental changes in the way music is heard, played, and written.

Commodore 64 and 128 owners will not find it surprising that their computers have been among those in the first wave of machines to serve as digital creators and controllers in this age of new music. With the versatile three-voice SID chip (see "Exploring the SID Chip" elsewhere in this issue), the 64 has been used as a musical playground and serious tool for five years. Now the 128, with twice the memory, is also drawing its share of ovations.

MIDI Miracles

Even more important during the same five-year period, however, has been the birth and exhilarating growth of MIDI—the Musical Instrument Digital Interface that is al-



tering virtually every aspect of music today.

"Anything you hear coming out of a speaker today has been affected in some way by digitization and MIDI," says Ullman. "A Commodore 64, for example, through MIDI can run up to 16 different synthesizers."

Even at a time when such new-generation computers as the Apple Macintosh, Commodore Amiga, and Atari ST are further extending the boundaries of computer-controlled music, the 64 and 128 still serve as focal points for a great deal of interest among musicians and beginners. And there's a host of music software packages and MIDI interfaces as well.

Those unfamiliar with MIDI may at first have difficulty understanding just how important MIDI has become to today's music. At its simplest level, MIDI is a set of technical specifications for connecting electronic musical instruments, such as synthesizers, drum machines, digital keyboards, sequencers, reverb units, and—importantly—computers. These specifications mean that what music you create on your synthesizer or computer or drum machine can be passed to, and understood by, another instrument following the MIDI standard. The MIDI specs were adopted in 1982 by a core group of influential instrument makers who realized that the future of electronic music would be a lot brighter if they worked together from the beginning to prepare a compatible communications standard.

The results of that agreement have been far more successful in a much shorter time than anyone could have forseen thanks to the amazing speed of change in digital technology and computers.

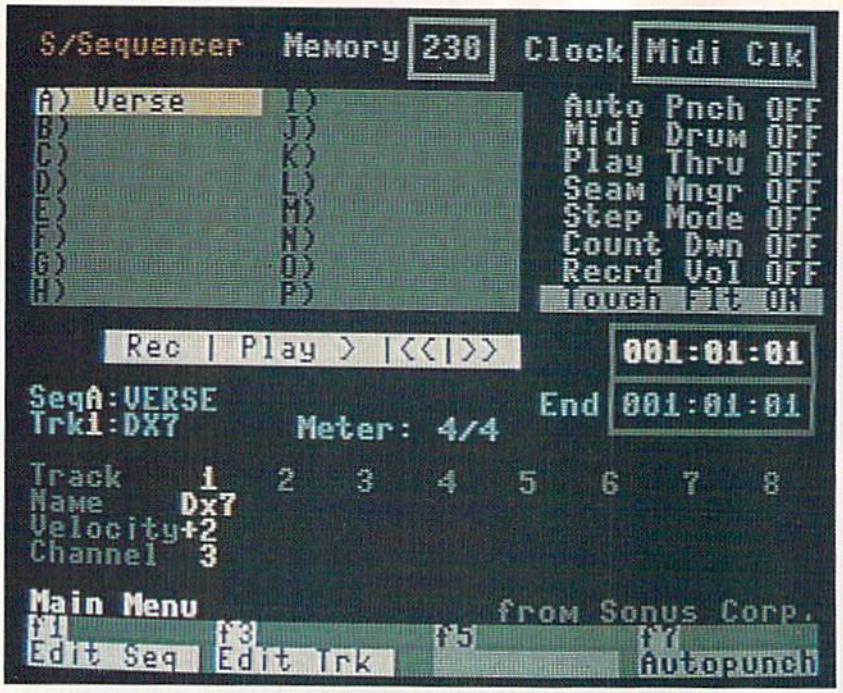
What MIDI means to a Commodore 64 or 128 owner is that, through a MIDI interface hooked to it and by using the appropriate music software, the computer can control up to 16 different MIDI-equipped instruments at one time. A MIDI interface fits into the Commodore's expansion slot and, at the other end, plugs into whatever MIDI instrument you want to send to and receive from. There are MIDI interfaces for the 64 and 128 ranging in price and optional features from about $75 to $200 available from RolandCorp US, Dr. T's Music Software, Sonus Corporation, and Passport Designs.

The MIDI connection contains a MIDI IN port for receiving digital data and a MIDI OUT port for sending data. MIDI THRU ports are used to pass data along a line of connected instruments. There are 16 separate MIDI channels that can be used, which gives you an idea of the staggering number of variations even the novice musician can create and control. So widespread has MIDI use become that virtually all electronic musical instruments are MIDI equipped, and the Atari ST computer comes with a MIDI interface already installed.

A Mountain Of Music

Over the past several years, software developers have produced music programs for virtually every aspect of music creation, performance, and practice. They range from professional-level performance and composition packages to introductory and educational programs for youngsters and adults.

There are many sources for this information, but one of the most complete and attractively packaged music software guides is the Coda catalog from Wenger Corporation's Music Learning Division. The 1987 guide contains 160 pages of music software information, including 40 pages on Commodore 64 and 128 programs alone. The book is illustrated and the listings are well annotated.



A MIDI sequencer program can offer sophisticated music composing, editing, sequencing, and other features that let the 64 and 128 work with a variety of digital electronic music instruments.

There are basically three broad categories of music software, although many programs fall into two and sometimes all three of these divisions. First, there are the professional-level MIDI sequencers, editors, music libraries, processors, and recording studios which are transforming the ways professional musicians and talented amateurs approach both composing and playing.

For example, Dr. T's Music Software, Passport Designs, and Sonus Corporation all offer a variety of sophisticated MIDI packages for the 64 and 128. Dr. T's *C128 Keyboard Controlled Sequencer (KCS)* is an enhanced version of the company's popular *KCS* for the 64. Sonus offers its *Super Sequencer* in 64 and 128 versions. And Passport has, among other programs, the *MIDI/4 Plus* and *MIDI/8 Plus* recording systems for the 64 and 128. Other 64 and 128 MIDI products include Roland's *MUSE* 8-track recording system and Firebird Licensees' *Advanced Music System.*

"MIDI is where things are happening in music these days," says Roland's Ullman. "The MIDI interface allows musicians to tap the capabilities of any MIDI-equipped synthesizer, from instruments costing a few hundred dollars all the way to top-of-the-line digital sampling keyboards that cost thousands of dollars.

"With a computer, the right software, and MIDI, the composer can run through his compositions before committing them to paper, much less hiring musicians and concert halls," he says. "If you don't like the way something works out, change it on the computer keyboard and try it a different way. The computer lets the composer reorchestrate at will. In some ways, the computer is the greatest musical invention since the clavier keyboard itself."

Musical Playgrounds

A second major division of music software available today is what might be called creativity and entertainment programs aimed at making the computer a musical playground. For the 64 and 128, there are literally dozens of examples of this type of software, ranging from simple programs that use the SID chip to play back songs all the way to professional-level *construction set* programs that can be used by beginners and experienced musicians alike.

There are a broad range of companies that have made 64 and 128 music programs of this type available, including Activision's *Music Studio*, Brøderbund's *The Music Shop*, Electronic Arts' *Music Construction Set*, Mindscape's *Bank Street MusicWriter*, and many more.

These music programs let the beginner experiment in an onscreen environment that's not as intimidating as the more advanced MIDI programs, but also offer a long list of additional features that can be used by the more experienced musician, and by beginners as their abilities grow. There are usually preprogrammed musical pieces that come with the programs, an easy-to-use menu system with recognizable icons and other symbols, and an interactive approach that lets the user hear and see in realtime what's being composed.

One of the most innovative and interesting of the music creativity programs for the 64 continues to be *Cantus*, a program from Algo-Rhythm Software that actually

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composes its own three-voice musical improvisations after you decide the elements of tempo, tone, harmony, and other ingredients you want. The program was created several years ago by Michael Riesman, keyboardist and conductor for the acclaimed Philip Glass Ensemble (whose recordings include *Songs from Liquid Days* and the soundtrack from *Koyaanisqatsi*), and there's still nothing quite like it. Although a beginner can have a lot of fun with this, experienced musicians have found it fascinating as well.

Classroom Composers

One of the most promising and fastest growing areas of music software is in education. Thousands of music educators have been discovering that computers can not only unleash the creativity of their students, but the right software can make music instruction less intimidating to beginners and can offer very specific practice environments on virtually every aspect of instruction.

Just how extensively computers and software are used in music instruction depends on individual music departments and how excited the teachers are about the new technology, says Daniel Kantor of Wenger's Music Learning Division.

"If the music teacher isn't using the technology, then computers are not a part [of the instruction], even if the school itself has lots of computers," he says. "Computers are opening up worlds of composition and experimentation to students who either don't have keyboard skills or are too young to have them. And they're allowing students at the early stages to think globally when it comes to composition."

New music packages aimed at the schools are emerging almost every day, with topics such as music theory, instrument fingering exercises, music appreciation, composing fundamentals, play-along exercises, ear training, music terminology, sight reading, instrument tuning, keyboard fundamentals, and many others.

"Almost unconditionally, the most popular type of program is that which lets you print your music," says Kantor. "A student shouldn't have to know how to notate music before he or she begins experimenting with sound. With the technology available, they can input examples themselves, or have the computer generate random examples, and then have the computer print out those examples."

Virtually all of the instructional music software developed over the past several years is available in versions for the Commodore 64 and 128. For example, Wenger offers a series of wind instrument fingering programs for almost every instrument: flute, oboe, bassoon, clarinet, saxophone, trumpet, French horn, trombone, tuba, and others. Other music software distributors such as Alfred Publishing and Electronic Courseware Systems also have 64 and 128 products on dozens of different subjects.

A Symphony Of Waves

Despite the recent proliferation of music software, everyone agrees that the marriage between computers and music has just begun.

"As artificial intelligence finds its way into music, we'll be getting programs that know something about musical style, and can recognize it," says Roland's Ullman. "So that, if you load a jazz composition, the machine will display and print your music in jazz notation.

"There's nothing, really, that can't be done in the way of controllers, either," he adds. "Once we have controllers for all instruments, there's no reason why we can't invent controllers for things that have never really been part of music before—a symphony for ocean waves beating against rocks, for example."

Al Hospers at Dr. T's concurs: "There's going to be software for more and more powerful computers. Some of the thinking will be done *for* you, as the software learns your style, learns your way of working and thinking about music, and adapts itself to that."

As more powerful computers and more sophisticated music software are developed, the boundaries of the possible will be extended in remarkable ways. But, for the forseeable future, the versatility and low cost of the Commodore 64 and 128 will continue to make them among the most popular of digital music machines.

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Exploring The SID Chip

Philip I. Nelson, Assistant Editor

Ever since 1982, when the Commodore 64 arrived on the scene, the SID (Sound Interface Device) chip has been making waves. Also found in the Commodore 128, the SID chip allows you to create sophisticated, three-part music and sound effects. This versatile chip revolutionized microcomputer music when it first appeared, and now, some five years after its introduction, it still is one of the best sound makers in any personal computer. Here's a close-up look at the fascinating world of sound in the 64 and 128. A demonstration program listing is included.

This article outlines the capabilities of the SID chip and provides a short program that shows off some of its flashier features. The program works on the Commodore 128 and the 64. Both of these computers use the same SID chip, but the 128's BASIC 7.0 offers several sound-related commands that are not available in the 64's BASIC 2.0. The BASIC 7.0 commands add some other capabilities—and have certain limitations—that are not inherent to the chip itself. If you control the chip directly with POKEs, you can use the same techniques on either machine; we'll look at basic features of the SID chip that are common to both computers. You can find more information in your user's manual and in the many books available for programming the 128 and 64.

Three Voices

The SID chip contains three separate tone generators, usually called *voices*. Each voice can create its own sound, completely independent of what the other voices are doing. Thus, to make a simple beep, for instance, you might cause voice 1 to beep and leave the other two voices silent. To emulate a bagpipe, you might play the melody with voice 1 and use voice 2 to drone in the background. Complex sound effects or multipart music can use all three voices at once. It's a bit like having a three-voice choir under your personal direction. Depending on what you dictate, the singers can sing alone, in harmony, or in any other combination.

Most human voices are limited to a single range (tenor, soprano, and so on), but a SID voice can change its character just by switching to a different waveform. In this way, the 64 can emulate many different natural sounds and create others which don't exist in nature.

The SID chip makes available four different waveforms: *triangle*, *sawtooth*, *pulse*, and *noise*. The figure illustrates the four SID chip waveforms, all of which are common in electronic music.

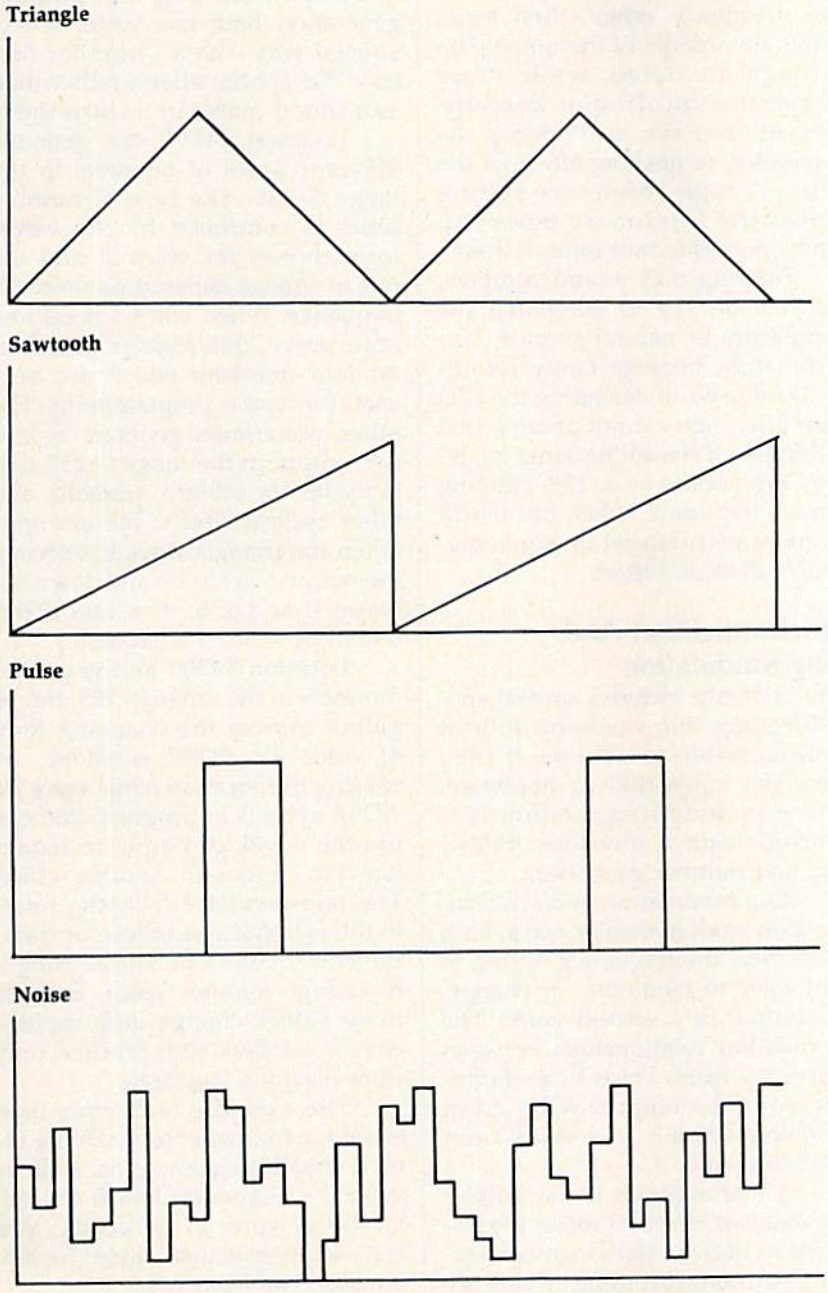
Each waveform has its own, distinctive character. The triangle wave creates a soft, flutelike tone. The sawtooth wave is louder and somewhat buzzy in comparison to the triangle. The shape of the noise wave is random (or nearly so), creating rushing and hissing tones that are useful for sound effects. The pulse wave creates a clear tone, like the triangle and sawtooth; by changing the width of its wave, you can make the pulse sound rich and full, or thin and reedy. A better name for the pulse wave might be *rectangular wave*, since its shape is always a rectangle of one sort or another. Another, somewhat less accurate name for this waveform is *square wave*. A square wave is simply a symmetrical pulse wave.

Each SID voice can use any of the four waveforms. For example, you might choose a triangle wave for voice 1, a sawtooth wave for voice 2, and a pulse wave for voice 3. In other cases, you might set all three voices to a triangle, and so forth. Except for some special effects (see below), the waveform setting for one voice has no effect on what other voices produce.

Envelopes

The *envelope* defines the shape of a sound over the course of its life, from beginning to end. To illustrate, consider the difference between two sounds: the sharp tap of a drumstick on a wood block, and a soft note on a cello. The wood block sound begins sharply and fades almost instantly, while the cello tone begins and ends more gradually, perhaps taking a second or two to fade completely into silence. The envelope of each instrument determines the character of a sound as well as how long it lasts. If the cello had the sharp, percussive envelope of a wood block, its notes would sound very different, indeed.

For the SID chip, as in conventional electronic music, a sound envelope is broken into four phases: *attack*, *decay*, *sustain*, and *release*.



The acronym ADSR represents these phases and often is used to mean an envelope generally.

The ADSR settings for a given sound describe a set of relations between volume (loudness) and time. The attack setting describes how rapidly a sound rises in loudness from silence to its peak volume. The attack for the wood block, for instance, would be very rapid, almost instantaneous, while the attack for a cello would be more gradual.

The decay setting describes how rapidly a sound fades in loudness from its peak volume to the volume at which it will be held, or sustained. This setting is most significant, of course, for sounds that will be sustained for an appreciable length of time. A sound like the click of two colliding billiard balls fades so quickly that it has, for practical purposes, no decay or sustain. A sustained trumpet note, on the other hand, lasts long enough so that decay is important.

The sustain setting describes how loud a sound will be during the period in which it is held at a constant volume. Not all sounds are sustained, of course. It's important to note that sustain is a *volume* setting, not a duration setting. Sustain controls the loudness of a sound while it is being held, not the length of time it is held. The sustain phase of the envelope ends when you *ungate* the voice, as explained below.

The release setting describes how quickly the sound fades from its sustained volume to silence. If you strum loudly on a guitar, or play a piano chord while pressing the piano's right pedal, those instruments create tones with a long release phase. The notes fade gradually as the strings of the instrument lose more and more energy. The release phase of an automobile horn, on the other hand, is very brief or nonexistent; the sound fades almost instantly when you release the horn.

You can create many simple sounds with the SID chip by using only attack and decay, ignoring sustain and release. For instance, if you set attack at 0, decay somewhere in the range of 8 to 13, sustain at 0, and release at 0, the sound begins immediately and fades naturally within a short time period—ideal for simple music and arcade-style sound effects. With an attack of 0, the sound begins instantly, with no perceivable delay, and the decay value determines how fast it fades in volume. If sustain is set at 0, the sound is not sustained at all: The sound decays all the way to zero volume, silencing the voice without further intervention on your part. Before making another sound with this voice, however, you must ungate the voice.

Gates

Closely tied to a sound's envelope is the concept of *gating*, or turning a voice on. Gating begins the ADSR cycle, which makes a voice produce a sound.

To gate a voice, you set the low bit of the voice's waveform control register to 1. To ungate the voice, you set the same bit to 0. For instance, the statement POKE 54276,17 both selects the triangle wave for voice 1 and gates the voice, causing it to begin its ADSR cycle. The statement POKE 54276, 16 ungates the voice. The other two voices are controlled with similar POKEs.

If you choose a nonzero sustain setting, the sound will be audible after its decay phase is complete. Once the voice enters its

sustain phase, it *remains at the specified volume indefinitely* until you ungate it. At that point, the sound enters the release phase, fading into silence at the rate specified.

If you need to specify all four ADSR parameters, ungating the voice is as important as gating it, although, as explained above, you can sometimes simplify the process by leaving sustain and release at 0.

Volume

The SID chip's volume control is one of its most basic features. To make any sound at all, you must set the volume to some nonzero value. If this isn't done, it doesn't matter what else you do with the chip—no sounds will be audible. There are 16 volume settings, ranging from 0 (silence) to 15 (loudest).

Filters

The volume control register, location 54296, also serves as a type selector for the SID chip filters. By setting the appropriate bits in this register, you can turn on a band-pass, high-pass, or low-pass filter. The SID filters are subtractive, meaning that they suppress, or attenuate, a portion of the frequency range for a particular sound.

You can route any of the three SID voices through the filter. For instance, you might filter voices 2 and 3, leaving voice 1 unfiltered. However, all filtered voices are affected in the same way; you can't select a band-pass filter for voice 1, for example, and a low-pass filter for voice 2.

A low-pass filter suppresses high-frequency tones in a sound, "passing through" low-frequency tones. A high-pass filter works in the opposite way, passing through high frequencies and suppressing low ones. A band-pass filter passes through only those tones within a narrow, specified frequency range, suppressing tones above and below it. You can use more than one kind of filter at a time. If you combine high-pass and low-pass filters, for instance, you get a *band reject* filter, which suppresses tones only within a specified range.

When you're using a filter, it's necessary to set the cutoff frequency, controlling the point in the frequency range at which the filter takes effect. For instance, if you select a low-pass filter and set the cutoff frequency at the middle of the 64's frequency range, then tones below the middle of the range pass through unaltered, while those above the cutoff spot are suppressed. You can also specify the resonance, or peaking effect, of the filter. A high-resonance setting makes the filter more powerful, while low resonance tones it down.

Filtering may sound complex, but it's the key to emulating the complexity of natural sounds. Unfortunately, because faulty formulas were used in designing the SID chip filter, you cannot assume that filtering will sound the same on every Commodore 64 or 128. Filtering always has some effect, but it will be more pronounced on some machines than on others.

Synchronization And Ring Modulation

The SID chip includes several special features that would be difficult or impossible to achieve if they were not supported in hardware. These include ring modulation, synchronization, envelope following, and number generation.

Ring modulation and synchronization work in similar ways; both effects use the frequency setting of one voice to modulate, or change, the output of a second voice. The modulation relationships between voices are fixed. Voice 1 can modulate voice 2's output, voice 2 can modulate voice 3, and voice 3 can modulate voice 1.

Synchronization is the simpler of these two effects. It mixes the frequencies of two voices together, creating harmonic overtones which are not present if the two voices are not synchronized. (The name for this effect is somewhat misleading. The word *synchronization* means a moving together, or in step. This does not mean, however, that the sounds for the two synchronized voices begin and end together. It is the *frequencies* of the two voices which are combined, not their envelopes.)

Ring modulation sums (combines) the two voices' frequencies, but suppresses the basic tones and accentuates the harmonic overtones which result from the summing. This feature creates strange, hollow sounds that can resemble the ringing of bells.

Number Factory

Envelope following and number generation both use voice 3 in a special way—as a "number factory" for special effects rather than as a sound maker in its own right.

Location 54299 can generate different series of numbers in the range 0–255. The type of number series is controlled by the waveform chosen for voice 3, and the rate of change depends on voice 3's frequency. When voice 3 is set to a noise wave, this register generates random numbers which are very useful in game programming. The other waveforms generate repeti tive output in the range 0–255 that is useful for vibrato, tremolo, and other cyclical effects. For example, when the triangle wave is selected, the output sweeps up and down between 0 and 255, at a rate determined by voice 3's frequency.

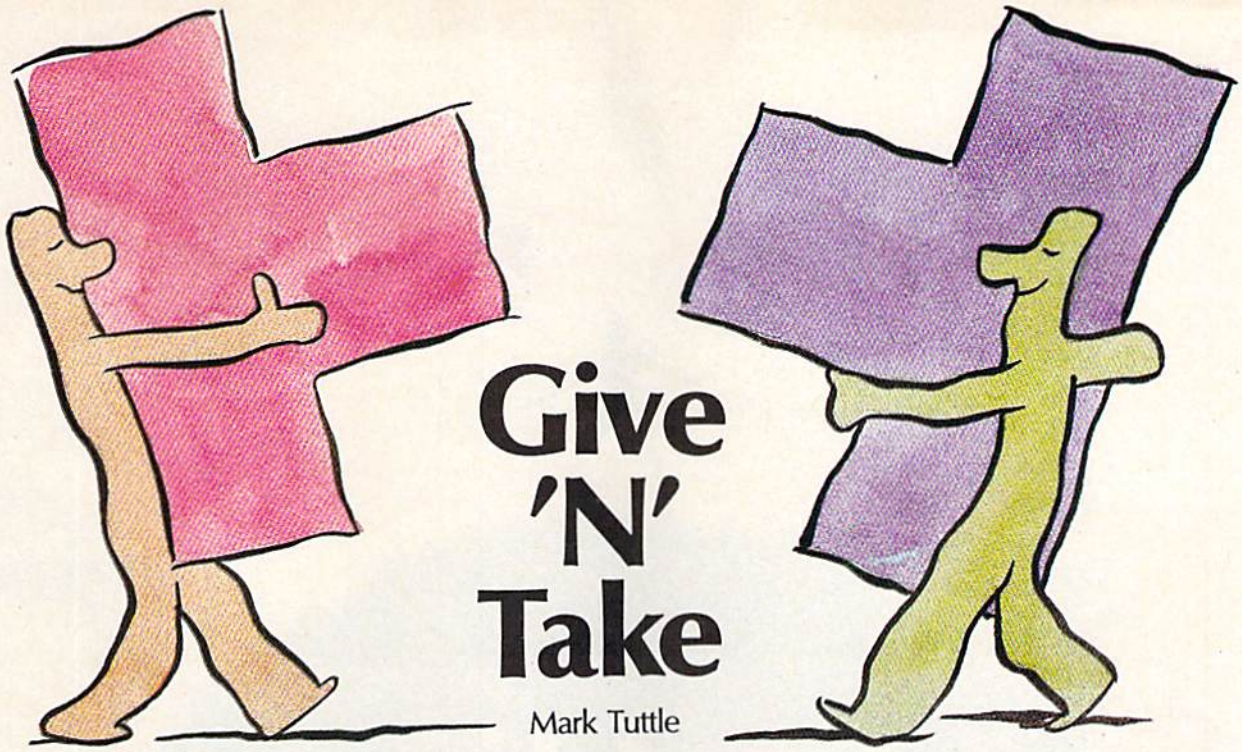
Location 54300 also generates numbers in the range 0–255, but its output mirrors the changing form of voice 3's ADSR envelope. By reading this location while voice 3's ADSR cycle is in progress, you can use the envelope output to modulate the output of another voice. The term *envelope following* refers to the fact that you follow, or track, the envelope of one voice, using it to change another voice. Because these values change very rapidly, envelope following is practical only from machine language.

The example technique uses envelope following to make the filter's cutoff frequency, as well as voice 3's frequency, follow the envelope of voice 3. Of course, you can use the envelope output for any purpose you like.

Example Program

The sample program for the Commodore 64 creates a highly complex sound effect with the aid of a short machine language routine which it POKEs into memory. Since its purpose is to show off the SID chip, the sound takes advantage of several special SID features, including ring modulation, filtering, and envelope following. Not every sound needs to be this complex, of course. But in sound, as in other areas, you'll find that the time spent learning programming details is usually well rewarded.

See program listings on page 84.



Give 'N' Take

Mark Tuttle

Challenge a friend or the computer to a battle of wits in this puzzle game for the 64. It's easy to play, but not so easy to win.

"Give 'N' Take" is a strategy game played on a jigsaw-puzzle board. The board is empty at first, but it quickly fills in as you and your opponent place your pieces. The game sounds simple—and it is—but there's a twist. When you put a piece down, all adjacent pieces turn to your color. This is beneficial to you in the variation called *Take*, but very hazardous indeed in *Give*.

You can play Give 'N' Take against either the computer or another player. In Give, try to end the game with fewer points than your opponent. In Take, try to finish with more.

Typing It In

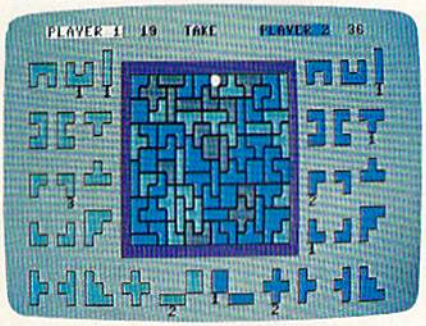
Give 'N' Take is written in BASIC. Since it requires accurate entry, type it in with the aid of the "Automatic Proofreader" located elsewhere in this issue. When you've finished entering the program, save it to disk or tape.

Before you can load and run Give 'N' Take, you must modify the computer's memory configuration. From immediate mode, enter this line:

```
POKE 43,1:POKE 44,64:POKE 16384,0
```

Then load and run the program.

If you own a disk drive, you may want to type in Program 2 and save it to disk. This program will perform the above POKEs for you and then automatically load and run Give 'N' Take. For the boot program to work, both programs must be on the same disk, and Program 1 must be saved with the name GIVE 'N' TAKE.



Two players place their pieces on the board in "Give 'N' Take," a unique strategy game.

Game Play

The first step in Give 'N' Take is to choose which variation to play: Give or Take. In Give, you try to force your opponent to capture pieces. In Take, you try to capture pieces.

Next, choose your opponent. You may play against a friend or against the computer. If you play against a friend, choose whether you want to use one joystick or two. If you use one joystick, plug it into port 2.

If you play against the computer, you must choose who should go first. Plug your joystick into port 2.

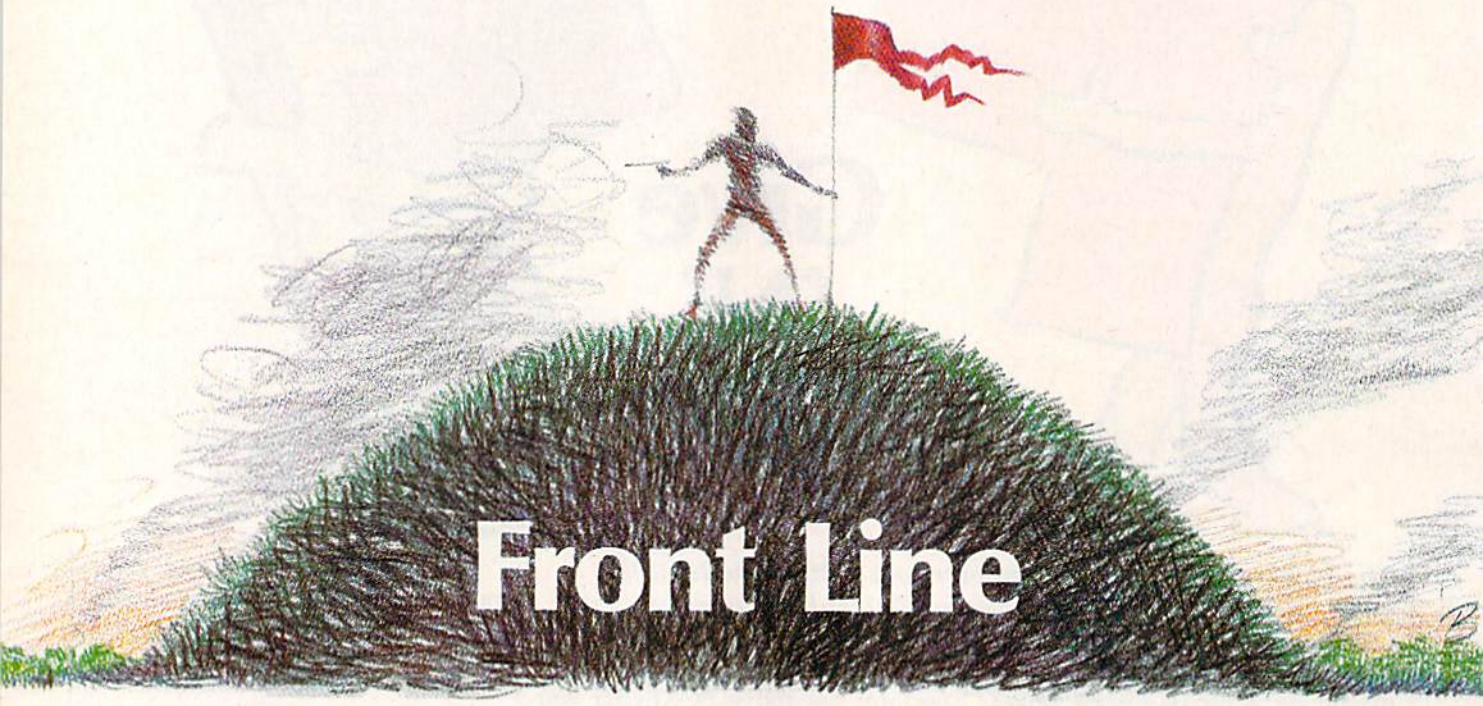
Give 'N' Take contains 70 puzzle-like pieces. These pieces are randomly divided at the beginning of the game—35 per contestant. Each of 18 unique shapes are displayed on both sides of the board—player 1 (green) on the left; player 2 (blue) on the right. Under each piece is a number which shows how many of that particular piece the player has.

Players alternate placing their pieces on the board. Unoccupied slots are gray. Move the game cursor (a white dot) to any region by moving the joystick left or right. When the cursor is on the slot where you want to move, press the fire button to place your piece. All occupied regions that share a border with the freshly taken space will change to your color. A running score is displayed at the top of the screen (each piece of your color is worth one point).

An attempt at an illegal move (such as trying to put a piece down on an occupied region, or trying to play a piece that you don't have) will sound a buzzer.

When all pieces have been played, the computer announces the winner. Press the fire button to play again.

See program listings on page 81.



Front Line

Georg and Paul Zimmer

This addictive two-player combat game for the Commodore 64 combines high-speed graphics action with board-game strategy. A disk drive is required.

In the near future, two platoons of disrupter-equipped men battle for control of the last remaining natural forest. Since the game begins with neither side at an advantage, the player with the best strategy and the surest reflexes will win "Front Line."

Typing It In

Front Line is written in both BASIC and machine language. Program 1 adjusts the memory configuration of the 64 and loads the main BASIC program and the machine language program. Type it in and save it to disk. Since it tries to load Program 2 from disk, do not attempt to run it at this point.

Program 2 is the main BASIC program. Type it in and save it on the same disk that you saved Program 1. You must save Program 2 with the name FRONT LINE.BAS because that's the name Program 1 looks for. Since the bottom-of-BASIC pointer must be adjusted before this program is loaded, Program 2 should be loaded and run only by Program 1.

Program 3 is the machine language portion of Front Line. Enter it using the "MLX" machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for the starting and ending addresses for the data you'll be entering. In this case, use the following values:

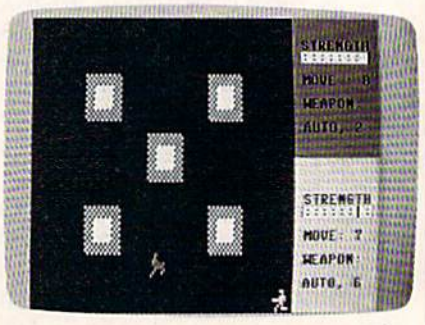
Starting address: C000
Ending address: C3BF

Be sure to save a copy of the program with the name FRONT LINE.ML before leaving MLX. (You must use the name FRONT LINE .ML because that's the name Program 2 looks for on the disk.)

Beginning The Battle

To begin play, plug in two joysticks and then load and run Program 1. After the title screen is displayed,

Two armies battle for a forest in the futuristic "Front Line."



In the game's action scenario, two men battle to the death for a strategically placed hilltop. Since each soldier has his own unique capabilities, every battle is different.

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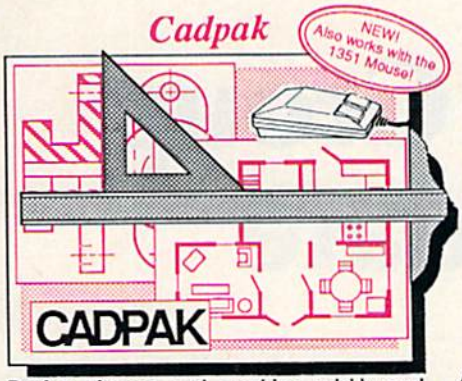

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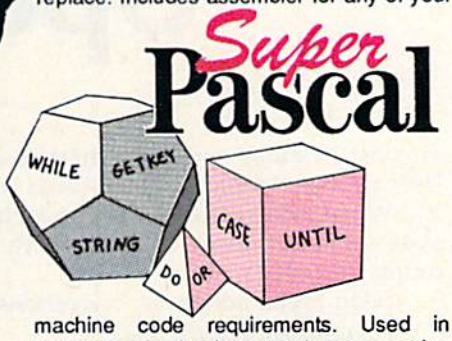

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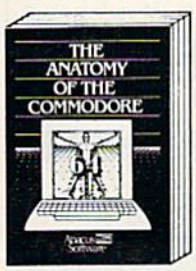

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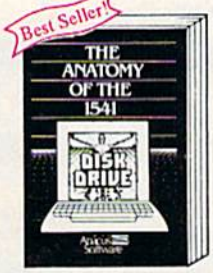

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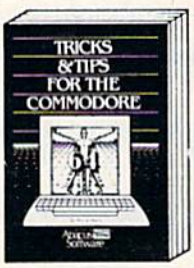

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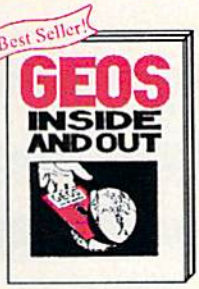

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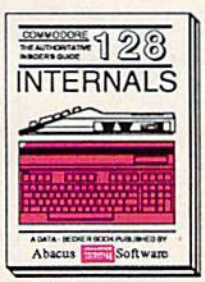

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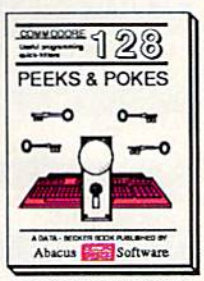

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you'll see the game's strategy board. This is an overhead map of the forest. The game begins with the Red Fighters lined up on the west side (left side of the screen) and the Blue Fighters lined up on the east.

Among the trees are three Control Mounds. These are strategic vantage points, hills from which the entire forest can be seen. If a player takes all three of these mounds, the game ends with that player declared the victor.

The Red Fighters make the first move. During this turn, you can move only one fighter. Use the joystick to position the cursor over the fighter you wish to move. Press the fire button to select the fighter. The cursor disappears, and you can now move the fighter freely within his range. Press the fire button again once you have chosen his destination.

When a fighter is selected, crucial information is displayed on a status line at the top of the screen, including his range, speed, type of weapon, and strength. It's important to consider the differences between the various fighters when choosing an opponent with which to do battle. After a while, you'll learn to identify the types of fighters by their body shapes.

The Mechanics Of Movement

The rules of movement are easy to learn: Once a fighter has been selected to move, he must be moved. A fighter cannot be placed on a tree or onto another fighter from the same team. In order to occupy a Control Mound, the fighter must be placed directly above the top of the hill.

When a player places his fighter directly on top of an opponent's fighter, hand-to-hand combat takes place. The two fighters enter an obstacle-filled arena (a new screen appears) and fight to the death. This part of the game calls for quick reflexes. Still, there is strategy needed even in this facet of the game. Different abilities and different weapons call for different tactics.

The game ends when all the fighters from one team have been destroyed or when one player takes all three Control Mounds.

See program listings on page 88.

User Group Update

This list includes updated entries to our annual "Guide to Commodore User Groups," which last appeared in the May and June 1987 issues.

When writing to a user group for information, please remember to enclose a self-addressed envelope with postage that is appropriate for the country to which you're writing.

Send typed additions, corrections, and deletions for this list to:

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Greensboro, NC 27403
Attn: Commodore User Groups

New Listings

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Club-64 (San Bernardino), P.O. Box 514, Patton, CA 92369

Lake County Computer Users, Commodore SIG, P.O. Box 385, Clearlake, CA 95422

ILLINOIS

Computers West, P.O. Box 3357, Glen Ellyn, IL 60138

Gateway Computer Club, P.O. Box 1839, Fairview Heights, IL 62208

LOUISIANA

Commodore Users Group of Slidell (CUGS), 111 Marche Blvd., Slidell, LA 70458

MARYLAND

Gaithersburg C-64 Users Group, P.O. Box 2033, Gaithersburg, MD 20879

MICHIGAN

Fellowship of Commodore Users and Supporters (FOCUS), 3897 Snow Rd., Berrien Springs, MI 49103

MISSOURI

East Central Missouri Commodore Users, P.O. Box 21, New Haven, MO 63068

NORTH CAROLINA

Western Carolina Commodore Beginner User's Group (WCCBUG), Rt. 2, Box 826, Forest City, NC 28043

OKLAHOMA

Univisions Users Group, 124 W. Frank St., Norman, OK 73069

PENNSYLVANIA

Sub-64 Users Group, P.O. Box 54208, Philadelphia, PA 19105

TENNESSEE

Memphis-East Commodore Organization (MECO), 6870 Sauterne Cove, Memphis, TN 38115

TEXAS

International Association of Commodore User Groups (IACUG), P.O. Box 890407, Houston, TX 77289-0407

VIRGINIA

Southside Virginia Commodore Users Group, 315 Lakeview Ave., Colonial Heights, VA 23834

Outside the U.S.

BRAZIL

Associacao de Usuarios de Micro-computadores Pessoais, Pedro Paulo Rocha, estr. da Canoa 401, 22600 Rio de Janeiro, Brazil

CANADA

AJ's User Group, 20 Davenport Cres., Ont., Canada L6T 3L6

Commodore Concepts Users Group (CCUG), Box 783, Steinbach, Manitoba, R0A 2A0

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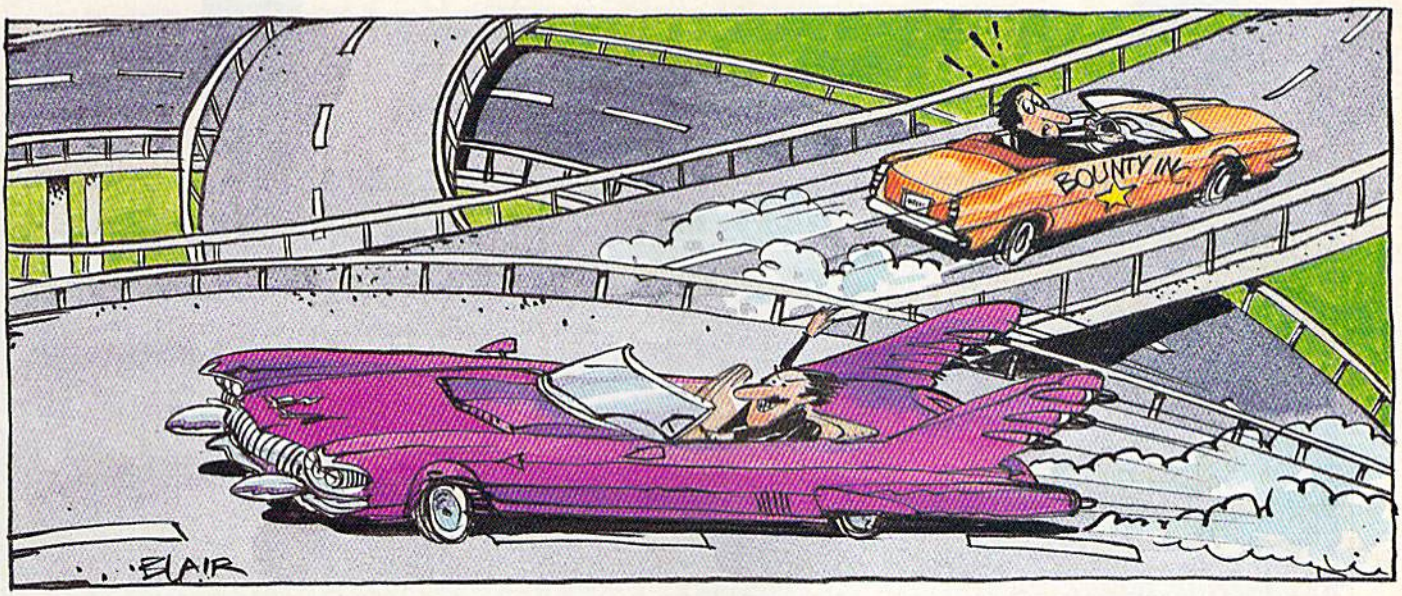
Bounty Hunter

Dan Aven



Here's an educational game for the 64 that's so enjoyable you may not even notice that you're learning US geography.

A crook is loose, and you're determined to collect the bounty. It won't be an easy job—you'll have to know your way around the country to find him. And when you finally track him down, you'll have to bring him back home to collect the reward. Rumor has it that his big brother is loose, and he probably won't be happy to hear that you've apprehended his baby brother.

"Bounty Hunter" is a game that requires knowledge of US geography. Don't worry if you're a little rusty, though—pressing the space bar will give you a clue. Eventually, when you've learned your way around, you won't need the clues as often.

Bounty Hunter has so many variations that you may never tire of the game.

Typing It In

Bounty Hunter is written in BASIC. It requires accurate typing, so be sure to use the "Automatic Proofreader" program found elsewhere in this issue. Pay special attention to lines 380–620 and 710–950, which draw the maps used in the game. Refer to the "How to Type In COMPUTE!'s Gazette Programs" article elsewhere in this issue if you have trouble understanding the representations of any of the graphics characters. When you've finished typing, be sure to save the program to tape or disk.

The Bounty Hunter has just crossed over into the western half of the US to catch the crook (in Idaho) and bring him home.

When you're ready to play, load the program and type RUN. You'll be asked to choose between *Bounty Hunter* and *Countdown*. In Bounty Hunter, you chase a crook across the country. In Countdown, you try to visit as many states as possible in the time selected (1–5 minutes.) It's a good way to warm up for Bounty Hunter.

After selecting a game to play, you'll be asked to choose between several variations. First, choose between *States* and *Capitals*. If you select States, you'll move by typing in the name of a state which has a common border with the state you are in. If you choose Capitals, you'll travel by typing in the names of capitals instead of the states they are in.

Next, choose between *visible* and *invisible*. Choose *invisible* only if you're an expert—you won't be able to see the map.

Finally, choose a skill level. Level 1 is the easiest and 3 is the most difficult.

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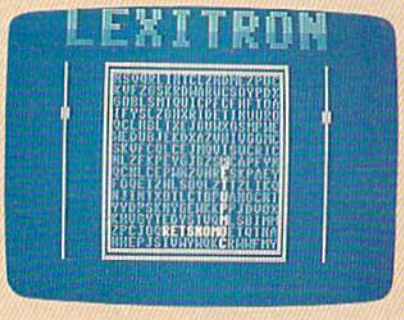

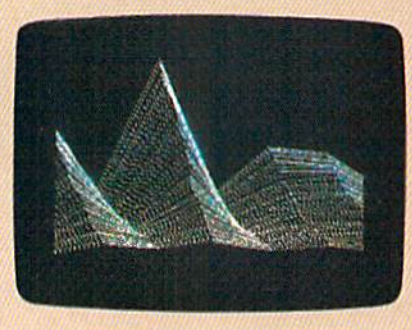

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The Hunt

If you choose the Bounty Hunter game, you'll be told the name of the state where the crook may be found. He probably won't be there for long, though, since he knows you're after him. The state in which you begin the game is the state that wants to bring the crook to justice. Be sure to remember this home state. You'll need to bring the crook back here when you catch him.

Don't rest a moment when you've caught the crook; his brother will be hot on your heels. Get the crook back home to claim your reward.

The map of the United States is divided into two halves: the East and the West. Five central states are on both maps (Minnesota, Iowa, Missouri, Arkansas, and Louisiana.) If you are in one of these states, pressing the cursor-right key will display the other map. If you are in any other state, this key will have no effect.

If you misspell the name of a state or capital, you'll see the message TRY AGAIN. If you enter the name of a state or capital which does not share a border with the state you are currently in, you'll get the message NOT A NEIGHBOR.

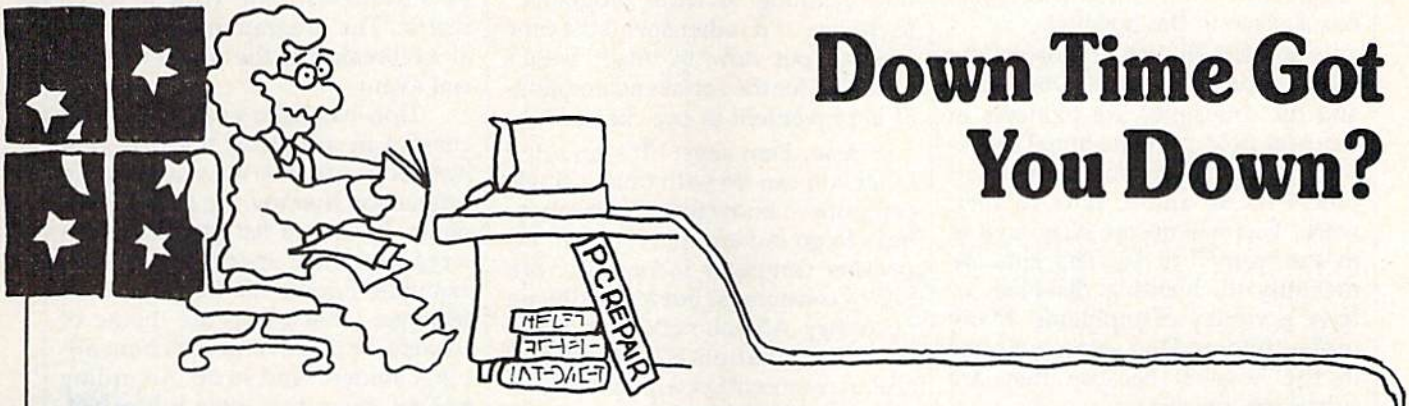
Desperate Measures

If you're really stuck, press the space bar. You'll see the name of one of the neighbors of the state you are in. If that state or capital would take you in the wrong direction, press the space bar again for another choice. Keep pressing until you've found the state or capital that you want. Type the name in when you've found it.

If you catch the crook, but forget where you're supposed to take him, press the RETURN key. You'll see the name of the state or its capital.

A $10,000 reward is offered for bringing the crook to justice, but this amount is reduced by $100 each time the crook moves from one state to another. The crook moves very rapidly at the higher difficulty levels, so it's possible that the bounty amount will become negative.

See program listing on page 78.



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Fred D'Ignazio
Associate Editor

COMPUTE! and COMPUTE!'s Gazette are proud to be the leading magazines in "home, educational, and recreational computing." I used to think that recreational computing belonged in the home and the classroom. Now I've learned that it also has a place in the hospital.

In Wabash Valley Hospital in West Lafayette, Indiana, Don Wood and his colleagues are pioneers in the new field of recreational therapy, and they use Commodore computers—a 64 and a 128—in their work. Their clients are kids ranging in age from 7 to 16. The kids are mentally ill, learning disabled, or have a variety of problems. Many of the children Don works with are in the hospital because they are substance abusers.

Three years ago Don and his associates at Wabash got a grant from the Ray Foundation in Colorado to purchase a Commodore 64, some Commodore peripherals, and software. Since then, the foundation has also enabled the hospital to purchase a Commodore 128 and additional software.

The Computer As A Tool

Don says, "Our goal with our 'special population' is not to teach computer programming, but to teach our children how to get along with others, using the computer as a tool. For us, the *process* is more important than the tool used. If they learn some programming at the same time they're learning some basic social skills, that's fine."

Although Don's staff has purchased popular commercial programs such as *Print Shop* and *Ghostbusters*, most of the programs the children use are from COMPUTE!'s Gazette and other computer magazines.

Among the most popular Gazette programs at Wabash are *SpeedScript*, "Typing Derby," "Aardvark Attack," "The Viper," "Arcade Baseball," and "Sea Route to India."

Don's students do very little programming on their own. "I'm not wasting my time or my students' time learning to write programs," says Don. "I'd rather spend the time figuring out how to adapt what's available for the social and emotional improvement of my clients."

Also, Don says, "It's amazing what you can do with only a single computer. I know it's popular these days to go out and purchase an expensive computer laboratory with lots of computers, but it's really not necessary. All you need is imagination. Imagination is a wonderful tool in combination with basic computer programs, and we try to use both to their fullest extent."

For example, Don's students pulled "Clues," a question-and-answer program, from the August 1983 issue of COMPUTE! and turned it into the "Substance Abuse Quiz" which they gave to each other and to incoming Wabash patients. According to Don, the quiz is a simple set of questions on alcohol and drug abuse, with two tries at the answers—which clients learn through Addiction Services education sessions during a three-week inpatient period. Don assisted three clients who collected the data, then typed it into the program. He and his students are currently revising the program to develop pretests and posttests for the Addiction Services program, and to gauge incoming patients' knowledge, reading and learning ability, and motivation. The program has been a big hit with Don's students.

Don found another program from an old magazine and extended it from pure recreation into recreational therapy. The program is a word search game which hides targeted words horizontally, vertically, and diagonally in a two-dimensional matrix. When new students arrive at the Substance Abuse unit at Wabash, Don has them type their names into the program, and then try to find each other's names in the find-a-word matrix. The program makes an ideal ice breaker at the unit's first social event.

Don has been even more successful in adapting the program into both an interview and social interaction therapy. He and his students develop a list of words centered around a specific topic—for example, family, the hospital, their feelings, what's fun, the theme of the day, or positive words about another student, and so on. According to Don, these lists often reveal attitudes and values more than a client would normally share. He says they also provide an impetus to his students' "creativity and the necessity to look beyond the surface, as well as using certain social skills, such as tact."

As with all of Don's other computer activities, the specific goal of each program is less important than the social and emotional improvement of his students. He says, "Group interaction, learning to get along with others, and encouraging use of a computer as a hobby are our primary goals with this program."

If you're interested in learning more about using Commodore computers with programs for recreational therapy, write Don Wood, Acting Assistant Director, Activity Therapy Department, Wabash Valley Hospital, 2900 N. River Rd., West Lafayette, IN 47906.

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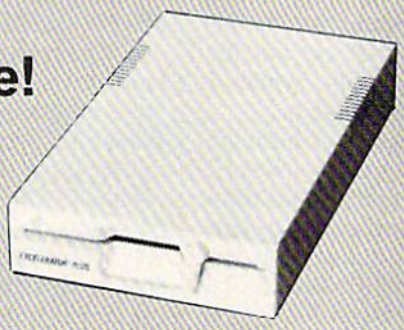

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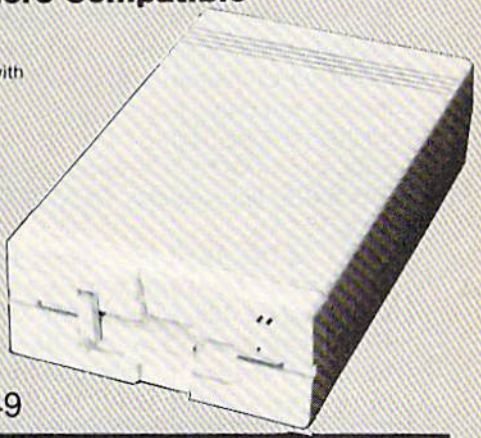

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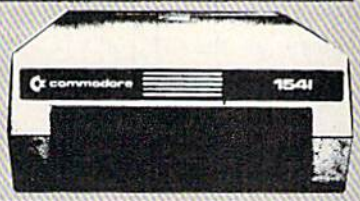

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simple answers to common questions

Tom R. Halfhill, Staff Editor

Each month, COMPUTE!'s Gazette tackles some questions commonly asked by Commodore users. If you have a question you'd like to see answered here, send it to this column, c/o COMPUTE!'s Gazette, P.O. Box 5406, Greensboro, NC 27403.

Q. In the April 1987 issue, you answered the question "Can a Commodore 128 emulate an MS-DOS computer?" I would like to have the answer to this question in reverse: Can an MS-DOS (IBM PC-compatible) computer emulate a Commodore 64? I have recently acquired a 640K PC clone and would like to have a program that would allow me to use my four years of Commodore work on my new computer.

A. The general emulation principle stated in the April 1987 column applies here as well: *Any computer can emulate any other computer as long as speed is not a consideration.* You might consider this as the "First Law of Emulation."

The Second Law of Emulation might be: *Any computer can emulate any other computer as long as expense is not a consideration.*

Which brings us to the Third Law: *In general, therefore, forget about emulators.*

Although an MS-DOS computer is more powerful than a Commodore 64, it is not powerful enough for this job. For one computer to successfully emulate another in software, it probably must be several orders of magnitude more powerful than the computer it's attempting to emulate. Most MS-DOS computers use the 8/16-bit 8088 or 8086 chips, and they simply aren't powerful enough to emulate the 8-bit Commodore 64 with anything close to full compatibility and full speed.

If anyone attempted to write a 64 emulator for the PC, they'd run into serious problems right off the bat. For one thing, the beeper found in most PCs can't come close to imitating the sounds that are possible with the 64's SID chip, which is practically a minisynthesizer.

Graphics are another problem. MS-DOS computers have no hardware to generate sprites like those built into the 64. Sprites can be simulated in software, but even in machine language you'd have trouble matching the speed and flicker-free animation that 64 programmers take for granted. Most MS-DOS computers also can't display a screen with 16 simultaneous colors, as the 64 can.

The result? A 64 emulator that would have difficulty with programs that use graphics or sound—which eliminates about 90 percent of all Commodore 64 software.

Someone could design a plug-in board for MS-DOS computers that incorporates a SID chip, a VIC-II graphics chip, and a 6510 microprocessor. But they'd run into another problem—emulating the 64's operating system. The operating system (Kernal) is copyrighted, so you can't just copy it. Someone would have to undertake the same project that made PC clones possible—a complete rewrite of the operating system that performs the same functions without using the same code. This could easily require a year of programming and debugging.

The result would be the functional equivalent of a Commodore 64 on a plug-in board. Ideally, it would be designed to use the PC's keyboard and memory to save the expense of duplicating those components. But those aren't particularly expensive components, so the emulator board might cost nearly as much as a regular 64—especially since development costs would have to be recouped. Is there a large enough market of PC owners who want to run Commodore 64 software to make this investment profitable? It's doubtful.

Again, these principles apply to emulator schemes in general. Software emulation requires a vast increase in processing power, and most people with that much power probably won't want to run the old programs on the new machine, anyway. Hardware emulation is expensive to develop, and purists might not consider it emulation at all, since you're really just bolting one computer onto another. You could emulate a Cray-XMP supercomputer on a VIC-20 with the addition of enough hardware.

Perhaps the best advice for someone who buys a new computer but doesn't want to part with an existing software library is to hold onto the old computer, and try to find room for both of them on the same desktop.

Q. I have a Commodore 1541 disk drive which won't save any programs or data. It keeps giving me a Write-Protection Error. It loads programs fine. I have tried saving on several disks, but none of them works.

A. Two possibilities: Either the disks you're using are write-protected, or the write-protection sensor in your drive is faulty.

A 5¼-inch floppy disk should have a small notch cut into the right edge (as viewed when facing the label). If this *write-enable notch* is missing or covered with a piece of tape, the drive won't let you change anything on the disk. You can load files, but you can't save, delete, or even rename files.

If the notch is there, perhaps the sensor inside the drive that checks for the notch is malfunctioning. Have the drive examined by a qualified technician.

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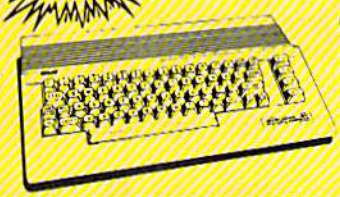

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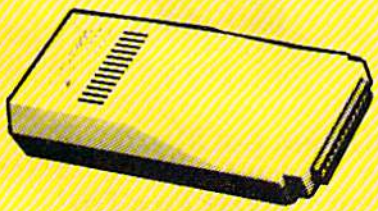

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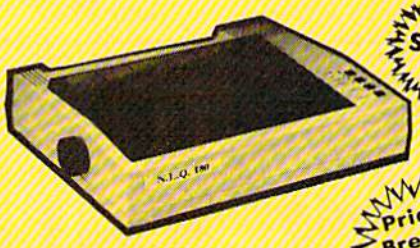

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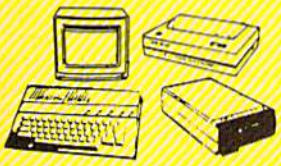

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Cadpak 128

If you are looking for a serious Computer-Aided Design (CAD) software package for your Commodore 128, *Cadpak 128* by Abacus may be the program for you. *Cadpak 128* allows the user to draw pictures and graphic designs easily and accurately on the screen. Like many other drawing programs, functions are provided for drawing lines, points, boxes, diamonds, circles, ellipses and other shapes, but there is one feature that makes it stand out from other graphics programs: With a dot-matrix printer, *Cadpak* can provide accurately scaled printouts—an important feature when precise drawings are necessary.

Cadpak is a complex, multifaceted program, but the logical structure of the menus makes it fairly easy to learn and use. Most of the functions require you to work through several menus before the actual function is completed. Though this may sound tedious, the flow of the selection process actually accelerates and simplifies your design work.

Before using *Cadpak* for the first time, it's necessary to configure the program for your printer. The list of supported printers includes: Epson MX, FX, and JX; Itoh Prowriter 8510; Okimate 10; Commodore 1525/801/803 or 1526/802; or any printer compatible with those listed. We used a Star NX-10 and configured the program for the Epson FX, with excellent results.

The actual size of the printout is dependent on the printer you use. Using a Commodore 1525/801 or Okimate 10, there is only one choice for the printout size—and the printout will be sideways on the paper. Most of the other printers enable you to print in two different sizes, but using the Epson FX configuration, you may select from five different sizes (three printed normally, two printed sideways). Clearly the program is most flexible with an Epson FX compatible printer. Before purchasing *Cadpak*, you should verify that it will work with your printer. If in doubt, check with your dealer or give Abacus a call. If your printer is not supported, the program will be worthless to you.

Proper use of *Cadpak 128* requires that you understand a few basic concepts. There is the total drawing area which has a resolution of 640 points wide by 360 points high. Since this area is greater than the pixel resolution of the computer, you actually view a window that is only one-fourth the total drawing area. This window may be scrolled both horizontally and vertically, so you are still able to work over the entire drawing area, and a feature called "top view" allows you to get a condensed picture of the entire drawing. Though the resolution is lower in top view, it is a convenient way to preview the complete drawing.

There is one feature that makes it stand out from other graphics programs: With a dot-matrix printer, Cadpak 128 *can provide accurately scaled printouts, an important feature when precise drawings are necessary.*

The primary purpose of any CAD software is to obtain accurately scaled printouts. Using *Cadpak 128*, you must always remember that everything on the screen is geared to the actual printout. With this in the back of your mind, the remaining concepts will follow quite naturally. Whenever you start working on a drawing, you must set three important parameters: the actual printing area, the base scale unit, and the scale ration.

Selection of the printing area is determined by your printer. As noted previously, the Epson FX allows you to choose one of five sizes. Once you've selected a size, you've determined the maximum printing area, which must be considered when selecting the other parameters. For example, let's suppose you select an area 8 inches wide by 5 inches high, which is one of the options for an Epson FX printer.

Now you must select the base scale unit. This may be either centimeters or inches. Again, let's suppose you select inches. The final parameter, the scale ration, requires a bit of computation before you can actually enter exact figures. Let's assume that the maximum size of the design will be 300 × 200 units. You must fit this 300 × 200 design into your printing area, which is set at 8 × 5 inches. Now, with a little calculating, you can choose your scale ration. You could choose a ratio of 40 to 1, which means that every 40 units will be 1-inch long on the printout. Dividing both 300 and 200 by 40, we find that this design would be drawn over an area 7.5 × 5 inches. That will fit within our total 8 × 5 drawing area, so it is an acceptable ratio. When the program calls for input as to the number of units to the inch, input 40, and you have established a scale of 40 units to the inch. If you want the drawing to be a little smaller, you can raise the ratio to 50 to 1; then this same 300 × 200 unit design will cover an area 6 × 4 inches.

The units we're referring to here can represent any unit of measurement: miles, feet, yards, inches, millimeters, even fathoms. If we choose a ratio of 40 to 1, the scale will be 40 miles (or feet, or whatever we choose) for each inch. With this in mind, it should be obvious that *Cadpak* can be used to design anything from a bridge to an integrated circuit—and the printout will be drawn accurately to scale.

Once you determine the basic parameters, you're ready to draw the design. There are two ways to draw on the screen: You can use a cursor and draw freehand, or you can determine lines and geometric shapes by setting points. The cursor can be controlled either by light pen or keyboard. The program requires frequent input from the keyboard, so keyboard control of the cursor seems to be more convenient than using a lightpen. Cursor movement is accomplished in two stages. First you rapidly move the cursor close to the area where you want to set an exact point, and then press RETURN. This places you in "Accupoint" mode, where you slowly and accurately position the cursor. This system is fast and precise, a pleasure to use.

You may find that the most sensi-

ble way to use this program is not by drawing freehand, but by setting points. When you realize that setting a point simply means determining the placement of the cursor by your own exact units of measure, you can begin to understand how CAD differs from simple drawing programs. For example: Let's say you'd like to outline the 300 × 200 unit area. You select the box option and set the first point at the lower left corner. Now you have to set the opposite corner of the box, which should be 300 units to the right and 200 units up from the first point. *Cadpak* allows you to enter points as absolute measurements from the point of origin, or as relative measurements from the last point set. In this instance, simply set the opposite corner by moving 300 units over and 200 up, relative to your first point, and press RETURN—you've created your 300 × 200 unit box. If we've chosen a scale ratio of 40 units to the inch, this box, when printed, will be precisely 7.5 inches wide by 5 inches high.

Cadpak also allows for precise line drawing based on angle and distance. If you want to draw a line that's 20 units long at an angle of 30 degrees to another line, you can do it easily by setting the first point, the angle, and the distance. Circles, arcs, and ellipses can be drawn with the same precision. Figures that are frequently used can be drawn and saved on disk as templates. These templates are then readily available and can be incorporated in any drawing.

Provision is made for labeling your drawing with one built-in font that can be printed in any of four sizes. You can even create your own fonts, save them on disk, and use them later in any drawing. Three additional fonts are included on the program disk. There are seven built-in patterns for use in filling in solid objects, and here again you can create your own fill patterns and save them on disk.

There are so many features in *Cadpak* that it's impossible to detail them all in a relatively short review. A short example, though, may serve to illustrate one of the many uses of this comprehensive program. I recently had my house and property surveyed, and I struck up a conversation with the surveyor and his assistant. I learned a fair amount about the basics of surveying from them, and they were kind enough to let me copy down their measurements. They also told me about the new and very expensive computer system their firm had purchased to make the actual drawings from their measurements. After they left, I rushed inside the house, booted *Cadpak*, and, using the measurements they provided, I had a perfectly scaled drawing of my house and property in less than 20 minutes. Surveying is largely a matter of straight line measurements and angles, a very easy chore for *Cadpak*. A week later, their survey arrived. Their scale was a little different than mine (my drawing was actually larger), but the drawings were perfectly matched in proportion to one another.

Although *Cadpak 128* is a wonderful and versatile package, there are a few negative points. While this program is designed on the 128, it uses the 40-column screen rather than the 80-column screen. This might have been a compromise decision, for use of the 80-column screen could have eliminated the need to scroll the window horizontally. Half the drawing area, instead of one-fourth, would have been visible in the window. The program is also heavily copy-protected, thus the rattle of the disk drive each time *Cadpak* is booted is quite annoying. Occasionally, the program wouldn't boot properly on the first try.

The *Cadpak* manual is scanty, not adequately explaining some of the basic concepts and lacking helpful hints and suggestions for using the program to solve "real world" design problems. The manual is essentially a basic reference with a few short tutorials. You'll have to experiment with *Cadpak* to take full advantage of all it offers, but the program is not only a highly productive tool, but also great fun to use. You'll thoroughly enjoy exploring its many uses. *Cadpak 128*, then, is highly recommended, though this review reveals only a brief glimpse of its full potential.

—Howard Parnes and Tyrone Adams

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FSD-2 Excelerator Plus Disk Drive

The Excelerator Plus is a new 1541-compatible disk drive for the Commodore 64 and 128 from Emerald Components International. Its predecessor, the FSD-1, entered the market last year and quickly became one of the most popular drives for Commodore users. In my opinion, the FSD-1 delivered much greater value for the price than the 1541, while remaining completely compatible with all software designed to load from a 1541 disk drive (see the review of the FSD-1 in the October 1986 issue).

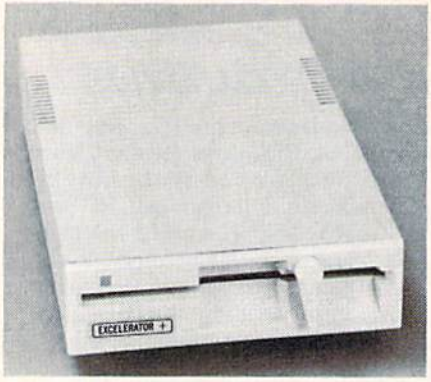
My enthusiasm for the FSD-1's reliability and performance was exceeded only by my enthusiasm for its low price ($139). One can imagine, therefore, the trepidation I felt when ECI announced the discontinuation of the FSD-1 and replacement of it with the Excelerator Plus. I have used my FSD-1 almost on a daily basis for over a year without a single complaint. With the FSD-1 seemingly having obtained perfection—considering the limitations of the drive with which it was designed to be compatible—how could ECI possibly top it?

Much to my surprise, however, I found that the Excelerator Plus incorporates noticeable technological improvements on the reliability and quality of 1541-style disk drives, including the FSD-1, while at the same time keeping 1541 compatibility. Additionally, the Excelerator Plus is competitively priced well below the 1541C.

The Excelerator Plus's advancements over the 1541, the FSD-1, and other 1541-compatible disk drives, are basically twofold. First, the power supply is a separate unit from the disk drive. A chronic problem with the 1541 and some 1541-compatibles is that the internally held power supply overheats with extended usage resulting in drive failure. While the FSD-1 had an improved power supply over the 1541, the power supply was still located in the drive casing.

Another advantage of separating the power supply from the casing is that the Excelerator Plus is much smaller than the 1541 and even the FSD-1 (the footprint of the Excelerator Plus is approximately 5½ × 11 inches with a height of only 2 inches).

The second major improvement incorporated in the Excelerator Plus is direct drive. The 1541, the FSD-1, and most (if not all) 1541-compatible disk drives are belt-driven. Audiophiles know that direct-drive turntables are better than belt-driven turntables because of what is known as *wow and flutter* (speed fluctuation) in belt-driven



The Excelerator Plus Disk Drive from Emerald Components

models. Speed fluctuation on turntables causes music distortion. Speed fluctuation on disk drives, something not uncommon on the 1541, causes program-loading problems, particularly with sophisticated copy-protection schemes. Direct drive, however, enables the Excelerator Plus to turn floppy disks at a constant 300 rpm without any discernable wow and flutter.

The Excelerator Plus incorporates several other improvements over the 1541. Like the FSD-1, the Excelerator Plus is housed in a durable metal casing the same beige color as the new 1541C. Its lock lever has been designed to securely hold a floppy disk in the drive and to prevent breakage of the lever by accidently twisting it the wrong way.

There is a noticeable improvement in the stepper motor and pulley on the Excelerator Plus, making drive alignment extremely tight and accurate. Drive alignment has perhaps been the worst problem for the 1541. Many Commodore users with two 1541s have found, much to their regret, that a copy of a program or data files made with one disk drive will not run on their other 1541 because of alignment discrepancies between the drives. The improvements in the Excelerator Plus are designed to prevent any alignment problems. Finally, the drive has two switches on the bottom of the casing that enable users to select the drive's device number (number 8, 9, 10, or 11 can be selected). Commodore users with two 1541s have to cut and solder wires internally to change the 1541's device number. With the Excelerator Plus, a simple flip of the dip switches will do the job.

The Excelerator Plus is over 99 percent compatible with the 1541, a statement that cannot be made of many 1541-compatible drives on the market. Most compatibility problems for 1541-compatible drives stem from the complex copy-protection schemes used on commercial programs. In the never-ending battle between copy-protection schemers and code busters, the protection schemes have become extremely complex, and play on the most remote and intimate details of the 1541's internals. Any slight deviation in a drive's internal operations from those of the 1541 could cause a copy-protected program to fail to load properly.

Many 1541-compatibles have been overly ambitious in trying to incorporate performance improvements in loading speed, storage capacity, and so on. However, those drives get into compatibility problems because such enhancements require significant internal modifications to a 1541. The Excelerator Plus has managed to be compatible with software designed to load from the 1541 drive.

The Excelerator Plus is over 99 percent compatible with the 1541, a statement that cannot be made of many 1541-compatible drives on the market.

To test the Excelerator Plus's 1541 compatibility, I used my Commodore 128, 1571 drive, FSD-1 drive, and two cartridges: Fast Load (from Epyx) and Mach 128 (from Access). Of the 250-plus programs tested on the Excelerator Plus, no original program disk failed to load. All the programs that would fast load using the Fast Load and Mach 128 cartridges with the FSD-1 and 1571 drives also loaded properly on the Excelerator Plus. A parameter copy of *Gemstone Warrior* would not properly load on the Excelerator Plus, but it also did not load on my 1571 disk drive. The copy of *Gemstone Warrior*, however, did load on my FSD-1. The programs that I tested included *GEOS* (Berkeley Softworks), *Newsroom* (Springboard), *Pocket Writer 2* (Digital Solutions), *Fast Hack'em* and *Ace of Aces* (Accolade), *World Games* (Epyx), *Alter Ego* (Activision), and *Fleet System 4* (PSI).

The only compatibility problem I experienced was in a two-drive setup with my 1571 drive. While the Excelerator Plus worked perfectly with productivity software, either as the program drive or data drive, I did experience a problem with *Fast Hack'em* and *Copy II 64/128*, two popular copy programs. Both worked well with the Excelerator Plus when copying with a single drive, but neither would copy a disk correctly in a two-drive configuration with the Excelerator Plus as the destination drive (the drive writing the new disk) and the 1571 as the source drive (the drive reading the original disk). However, if the Excelerator Plus was used as the source drive, both copy programs worked. These problems were not experienced between two Excelerators or an Excelerator and the FSD-1. Also, *Super Kit/1541* worked well with the Excelerator Plus in tandem with the 1571, regardless of which drive did what.

The user's manual provided with the Excelerator Plus is adequate, but will leave the advanced computerist with a lot of questions unanswered. The manual is essentially the FSD-1 manual, with few noticeable changes.

In summary, the Excelerator is a very attractive 1541-compatible disk drive for the Commodore 64 and even for the Commodore 128. After a thorough examination of the drive, my skepticism over ECI's decision to replace the FSD-1 with the Excelerator Plus has been dispelled. While not having any noticeable improvements over the 1541 in loading speed or storage capacity, the drive does have dramatic improvements over the 1541 in quality and reliability. As evidence of these improvements, ECI provides the Excelerator Plus with a full one-year limited warranty. Since the Excelerator Plus can be mail-ordered at approximately $159—about $30 less than the 1541C drive—any Commodore 64 or 128 user looking for a first or second disk drive should give the Excelerator Plus serious consideration.

—Scott Thomas

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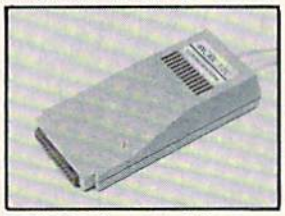

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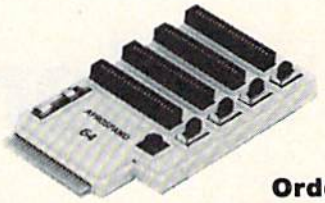

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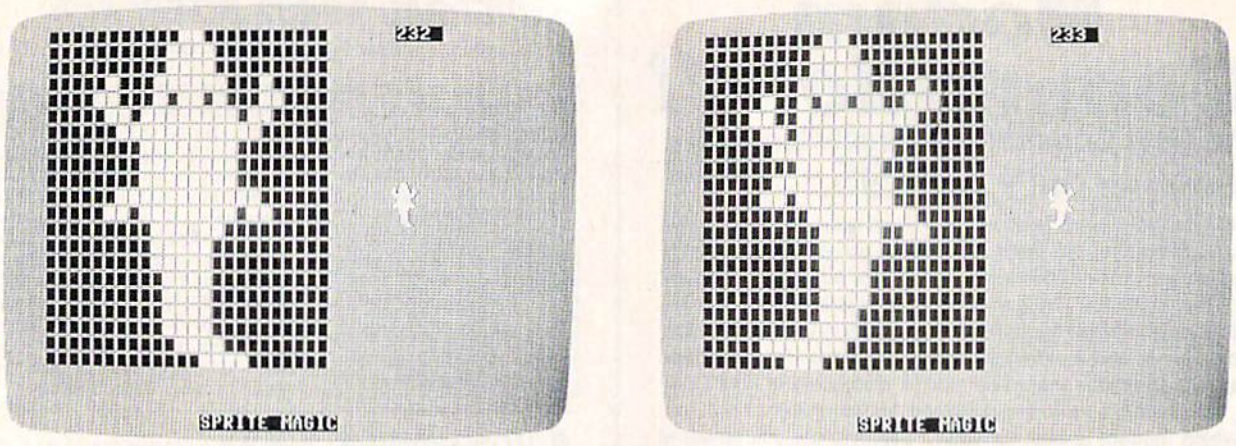


"Sprite Magic" makes it easy to design animated sequences. These two screen photos show an alligator in two stages of its crawl.

Sprite Magic

Charles Brannon

Three years ago this month, the Gazette debuted "Sprite Magic," an easy-to-use, full-featured sprite editor for the Commodore 64 that simplifies sprite creation and lets you concentrate on the artistic aspects of design. We're reprinting this very popular utility for those who may have missed it in the August 1984 issue. Following this article are three new sprite utilities—each compatible with Sprite Magic. Together, these four programs offer an exciting package that will help you use the powerful graphics potential of the 64.

Most of what you've read about sprites covers how to program them: setting them up, protecting memory, moving and animating them, and using them in games. But sprite design is usually left up to you.

A sprite is defined by 63 binary numbers. The 1 bits in the values represent solid pixels. Zeros represent blank areas in which the screen background is visible. Normally, you sketch a sprite on a grid 24 pixels (bits) across and 21 pixels high. This is 3 bytes per row (8 bits * 3 bytes = 24 bits) and 21 rows of bytes (3 * 21 = 63 bytes). But after you've drawn the sprite, you have to convert the squares into binary, and then into decimal so that you can put the numbers in DATA statements.

There are utility programs that will do the conversion for you, and even editors that let you clear and set squares with a joystick. Since you're using a computer, other functions can be supported to let you clear, invert, reflect, reverse, shift, and test out your sprite. The more work the computer does, the less you have to think in terms of binary numbers.

"Sprite Magic" offers the best features of most sprite editors, including true multicolor mode, and pulls it off with the speed and power of an all machine language program. Sprite Magic's style (and even some of the coding) is similar to that of "Ultrafont +," the custom character editor which appeared originally in the July 1984 issue. (A revised version was published in the September 1986 issue.) Many of the commands are the same, so you can get up to speed quickly. If you've learned how to use Ultrafont +, it won't be long before you're comfortable with Sprite Magic.

Typing It In

Since Sprite Magic is written entirely in machine language, you'll need to use "MLX," the machine language entry program found elsewhere in this issue. Be sure to read and understand the instructions for MLX before typing in Sprite Magic. When you run MLX, you're asked for the starting address and ending address of the data you'll be entering. For Sprite Magic, respond with the following values:

Starting address: **C000**
Ending address: **CA8F**

When you've finished typing in the data for Sprite Magic, be sure to save a copy to tape or disk before leaving MLX.

To load Sprite Magic, type LOAD "SPRITE MAGIC",8,1 (for disk) or LOAD "SPRITE MAGIC" ,1,1 (for tape). After the program has finished loading, you'll see the READY prompt. Type NEW and press RETURN. This resets some important memory locations, but leaves Sprite Magic in its protected

cubbyhole at address 49152 ($C000). To activate the program, type SYS 49152.

Doodle

After you've typed the SYS command, the main screen should instantly appear, with a large 24 × 21 grid. The grid is a blowup of the sprite you are editing. The actual sprite will be seen to the right of the grid. The flashing square within the large grid is your cursor. Move the cursor with either the cursor keys or with a joystick plugged into port 2. To light up a blank spot (in other words, to turn a pixel on), press either the space bar or the joystick fire button. If the square is already lit, it will turn dark. This signifies that the pixel has been turned off. The button or space bar thus toggles each point on or off. You can draw your sprite quite easily in this manner.

One fine point: With the joystick, you can hold down the fire button and move the cursor. If the first point you change was set, then the fire button continues to set points as you move the joystick, regardless of the other points' original state. If the first point you change was empty, then you can hold down the fire button and move about, clearing anything the cursor passes over. Notice how any changes are immediately visible in the actual sprite.

If you've just entered Sprite Magic, the grid is probably full of garbage pixels. To clear out the grid for a new picture, press SHIFT–CLR/HOME. You now have an empty area—a fresh canvas, so to speak—to draw on. You can press CLR/HOME without holding down SHIFT to home the cursor to the upper left corner of the grid.

Does the cursor move too slow or too fast? To change the velocity of the cursor, press V. Answer the prompt with a number key from 0 (slow) to 9 (very fast).

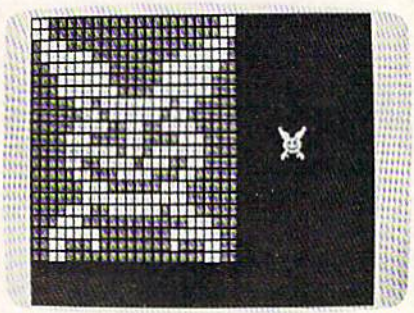
Shift, Expansion, And Symmetry

Sometimes when you're drawing, it's necessary to reposition the shape within the grid. The first two function keys let you shift the sprite shape around within the grid. If you shift something out of the grid, it wraps around to the opposite side. The f1 key shifts right; f3 shifts down. Use the SHIFT key along with the function key to move in the opposite direction: f2 moves the sprite shape left, and f3, up.

After you've drawn something, press F. Instantly, the sprite is flipped upside down. Press it again to flip it back over. Remember F as the command for Flip. Now try M (for Mirror). The shape you've drawn is mirrored left to right. Of course, if you've drawn something symmetrical, you may not see any change.

Now try CTRL-R or CTRL-9. The sprite will become reversed. Every square that was on is now turned off, and vice versa.

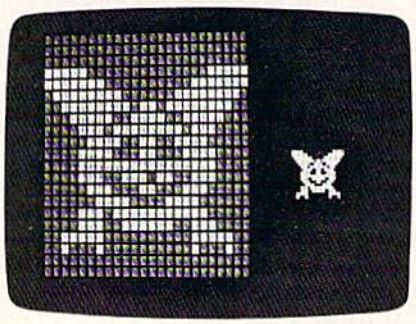
A sprite can also be expanded or contracted either horizontally or vertically, or both horizontally and vertically. The X and Y keys on the keyboard let you do this. Press X to switch from wide to narrow, or vice versa. Press Y to switch from tall to short, or vice versa. Regardless of your choices, the main grid will not change size or proportion.



The Symmetry option was used to draw this frightful eagle.

An unusual command is Symmetry. This command was added because many shapes are symmetrical from left to right, as if a mirror were put in the middle of the grid. To enter the Symmetry mode, press the back-arrow (←) key in the upper left corner of the keyboard. Now, every square drawn on one side of the design will be instantly mirrored on the other half. Blank squares are not copied over, though, so you cannot erase in this mode. This command is not only quite useful, but is also a great deal of fun to play with. To return to normal editing, press the back-arrow key again.

Notice the number in the upper right corner of the screen. This is the sprite-page number, which can range from 0 to 255. You start out at the top of the sprite memory. The plus and minus keys are used to go forward or backward through sprite shapes. Press the minus key—you immediately have a new shape in the grid.



X and Y expansion increases the size of the sprite by four times.

There is a limit to how far back you can go. If you have no BASIC program in memory, you can step back to sprite-page number 32. However, character information resides in sprite pages below 128. You can still clear the page and draw a sprite shape on pages below 128, but it won't really register. To be safe, *use only the sprite pages from 128 up.* If you have a program in memory, Sprite Magic will not let you step back past its end. This protects your program from being accidentally overwritten by a sprite shape. If you want maximum space available for sprite shapes, use NEW to erase any BASIC program before you SYS 49152. You'll sometimes want to keep a program in memory, however. We'll show you why a bit later.

A programming note: The sprite-page number, when multiplied by 64, gives you the starting memory location for the 63 numbers representing the sprite.

Put It In The Buffer

You might use Flip to design two views of a shape, such as a spaceship pointing in two directions. Draw one freehand; then create the other with Flip. (Mirror can be used to design separate left and right views as well.) But what you first need is a way to copy the original shape to another sprite area. One way to do this is to copy the sprite shape to an area of memory (a buffer). You can use plus or minus to

step to another sprite page, then copy the buffer to the sprite. (This, you may remember, is the way you copy characters with Ultrafont.) Press f7 to copy the sprite to the buffer. The grid flashes to affirm this. Then go to the sprite page where you want to put the copy and press f8 (SHIFT-f7). The shape in the buffer replaces any shape already in the sprite grid.

You can also use the buffer as a fail-safe device. Before modifying an existing sprite, press f7 to save it in the buffer. Then, if you mangle the sprite, or accidentally erase it, you can recall the previous shape from the buffer.

Computer Disney?

Since you can change sprite pages so easily, you can use Sprite Magic as an animation-design tool. Cartoons make only minor changes between frames. Too much change makes the animation jerky. So put the first frame into the buffer, copy it to the next area, and then make a change. Put the new image into the buffer, copy it again to a new area, and make another small change. Continue in this fashion as you build up a whole series of frames. Put different, but similar, shapes on adjacent pages; then hold down plus or minus to step through the shapes. As with cartoon animation, you will get the illusion of motion. (Use a cursor velocity of 9 for maximum speed.) So even if you don't care to program sprites, Sprite Magic is a fun tool for making moving cartoons.

A Bit Of Color

The normal drawing mode lets you set or clear points, but in only one color. If you're willing to give up half as many horizontal points, you can have four colors to work with. Multicolor mode lets any square be one of four colors, but gives you only 12 pixels across instead of 24. This is because two dots are grouped together to give four combinations. The colors come from four memory locations:

Pattern	Color location
00	53281 Background color register
01	53285 Sprite multicolor register 0
10	53287–53294 Sprite color registers
11	53286 Sprite multicolor register 1

Quick Reference Chart

B	Cycle through background colors
F	Flip sprite upside down
J	Move sprite with joystick
L	Load sprite patterns from tape or disk
M	Mirror sprite from left to right
S	Save sprite patterns to tape or disk
V	Set cursor velocity
X	Toggle horizontal expansion on/off
Y	Toggle vertical expansion on/off

CTRL-D	Create DATA statements
CTRL-R (or CTRL-9)	Reverse sprite
CTRL-X	Exit to BASIC

Plus key	Next sprite page
Minus key	Previous sprite page
CLR/HOME	Home sprite-editing cursor
SHIFT-CLR/HOME	Erase grid
Space bar (or fire button)	Set/clear points
CRSR keys (or joystick in port 2)	Move cursor
Back arrow	Symmetry mode
1–4	Select drawing color for multicolor mode
SHIFT 1–4	Change a drawing color

f1	Shift pattern right
f2	Shift pattern left
f3	Shift pattern down
f4	Shift pattern up
f5	Multicolor mode
f6	Normal mode
f7	Store pattern in buffer
f8	Recall pattern from buffer

There are two multicolor sprite registers, which are shared among all sprites (in programming, but not in Sprite Magic, you can have eight sprites on the screen at the same time). The bit pattern marked 10 is unique to each sprite, and comes from that sprite's own color register. Pattern 00 is blank, and whatever is underneath the sprite shape will show through.

The reason for this sojourn into bits and addresses is that only the ten-bit pattern has a unique color for that sprite. If you're designing several sprites for a game, remember that anything drawn in that color can be changed individually for each sprite. Squares drawn with bit pattern 01 or 11 will be colored from two locations shared by all sprites.

Many sprite editors let you see how the sprite would look in multicolor, but you still have to pair up the pixels yourself, and keep track of binary bit pairs. Since that's no fun, Sprite Magic offers a multicolor mode instead. When you press f5, the screen instantly changes. Each square in the grid is now rectangular, two squares wide. The cursor has also been enlarged, and can be moved about as before in the new grid. But the way you set and clear points has been changed, since you are now working with four colors.

Multicolor Palette

The fire button or the space bar always sets a point, but you have to tell Sprite Magic which color you are currently drawing in. The number keys 1 to 4 select the drawing color. The number you press is one number higher than the binary value of the bit pairs in the table above. The 1 key, for instance, chooses the 00 bit pair, which represents the background color. In practice, you are choosing from a palette of four colors. The 1 key can be used when you want to erase, although the fire button can still be used to toggle points on and off.

When you press a number key from 1 to 4, the border color changes to remind you which color you're drawing with. If you want to change one of the four colors, hold down SHIFT while you type the number. The prompt ENTER COLOR KEY appears. Now you have to enter another key combination. Press CTRL and one of the number keys from 1 to 8, or hold

down the Commodore key and one of the number keys from 1 to 8. These are the same key combinations you use to change the text color in BASIC. You can also change the screen background color by pressing the letter B on the keyboard until the color you want appears.

Some Sprite Magic commands act strangely in multicolor mode. For example, a shift left or shift right (done with the f1 and f2 keys, respectively) moves the sprite over by only one bit, which changes the color assignments. In general, you must press f1 or f2 twice to preserve the same colors. Pressing the M key (for Mirror) reverses the bit pairs, so that every 01 becomes a 10. The effect is that colors 2 and 3 are exchanged. The R (Reverse) key also inverts the bits, so that 01 becomes 10; 10 becomes 01; 00 becomes 11; and 11 becomes 00. Colors 2 and 3 are switched, as well as colors 1 and 4.

If you want to go back to normal (non-multicolor) mode, press the f6 key (SHIFT-f5). There's nothing to prevent you from designing both normal and multicolor sprites on different pages.

If you changed colors in the multicolor mode, some of the colors in the normal mode may have been changed. You can alter these colors as in multicolor mode. Press SHIFT-1 to change the color of the empty pixels, and SHIFT-2 to change the color of the pixels that are lit. (You'll be prompted to press a color-number key after each SHIFT-1 or SHIFT-2 combination. Remember to press either CTRL or Commodore simultaneously with the color key.)

Mobilizing Your Sprite

If you want to try out your sprite in action, press J (for Joystick). You can now move the actual sprite around with the joystick. The speed of movement depends on the current cursor velocity. When you've finished putting your sprite through its paces, press the fire button to return to Sprite Magic. Also, if you want to test the animation while you are moving about, hold down the SHIFT key to step forward through the pages of your defined sprites, or the Commodore key to step backward. You can use the SHIFT LOCK key to keep the animation happening while you move around.

Saving Your Sprites

After all your work, you surely want to save your creations on tape or disk for future use. You can save an individual shape, or all the sprites. Press S (for Save), then either D (Disk) or T (Tape). Next, enter the filename. You'll be asked, "Save all from here?" If you press N (No), then only the current sprite pattern you are working on is saved. If you press Y (Yes), then every sprite pattern from the current sprite page to sprite 255 will be saved. Thus, if you want to save a range of sprite patterns, be sure to use the minus key to step back to the first page you want saved.

To recall your sprites, press L. The Load command loads everything that was saved. If you're loading in more than one sprite, be sure you step backward far enough with the minus key so that all the sprites will fit between the current sprite page and sprite 255. The sprite patterns load starting at the current sprite-page number. After you've pressed L, enter T for Tape or D for Disk.

Making Sprite DATA

If you're a programmer, you're probably more interested in DATA statements. That way, you can use BASIC to READ and POKE the numbers into memory. Using a DATA maker program, you can run it on the memory used by the sprite in Sprite Magic (again, the memory location is the sprite number multiplied by 64). But Sprite Magic has a special DATA maker of its own. It's similar to the Create DATA option in Ultrafont, but it's been enhanced.

Press CTRL-D to create a series of DATA statements from the current sprite in memory. Just tap the key, or you'll get hundreds of DATA statements as the key repeats. Sprite Magic will create eight DATA statements, with eight bytes per line. The last byte is not strictly used. Sprite shapes are made from 63 bytes, but the sprite areas are padded out with one additional byte so they will conveniently fall in 64-byte groups. To create DATA statements for another sprite, use the plus or minus key to move to the correct sprite page; then press CTRL-D again.

If you have a program already in memory, the DATA statements are appended to the end of the program, starting with the next available line number. To add DATA statements to an existing program, then, first load Sprite Magic. Type NEW. Load your BASIC program, and SYS 49152 to enter Sprite Magic. You can then load in sprite shapes and use CTRL-D to add those DATA statements to the end of the BASIC program in memory.

You can check to see that these DATA statements were added by exiting Sprite Magic (press CTRL-X) and typing LIST. Your program should have eight new DATA lines for each sprite pattern. If there was no program in memory, the DATA statements form a program all their own, starting with line 1. If you want, you can save just the DATA statements to tape or disk, using the normal SAVE command.

To exit Sprite Magic and return to BASIC, press CTRL-X. You can also use RUN/STOP–RESTORE.

See program listing on page 75.

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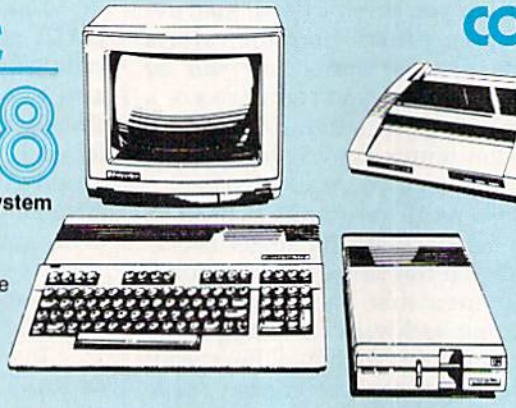

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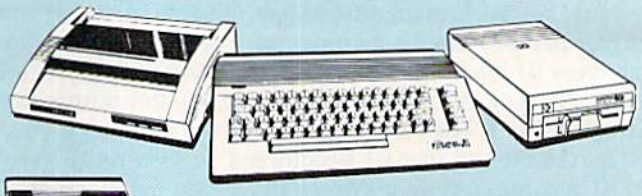

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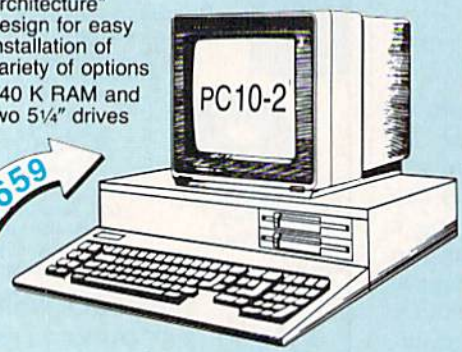

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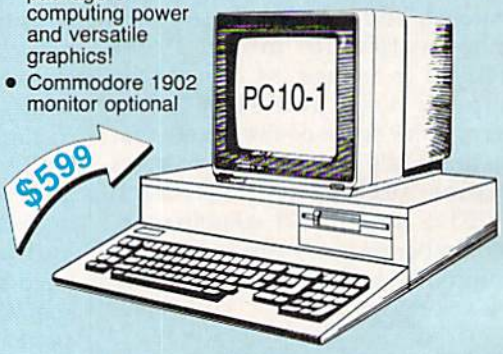

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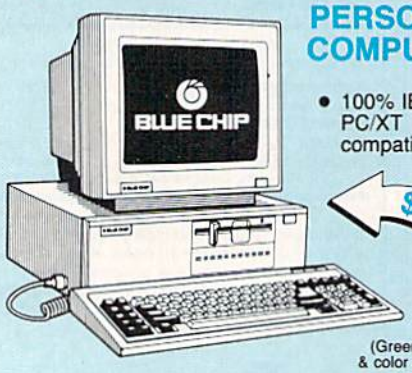

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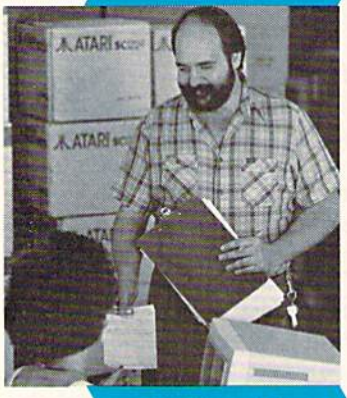

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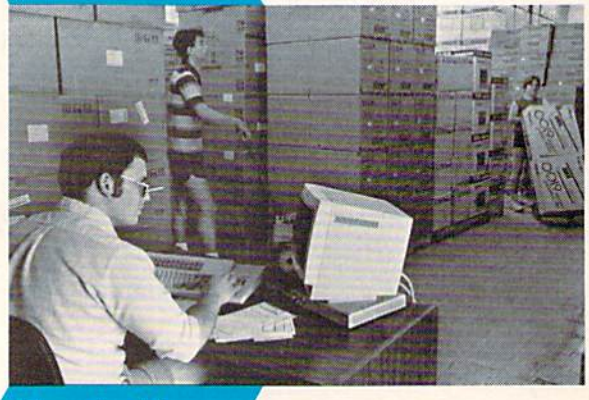

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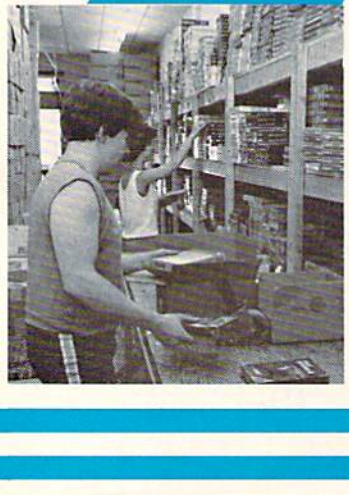

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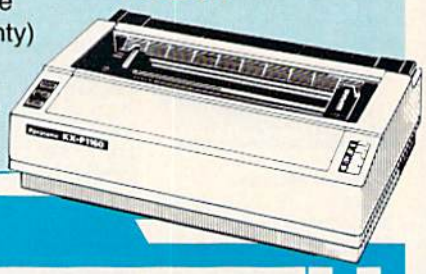

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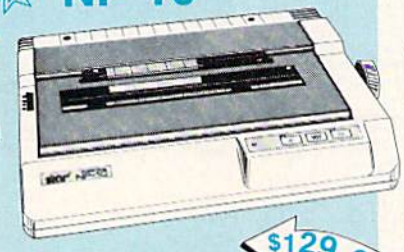

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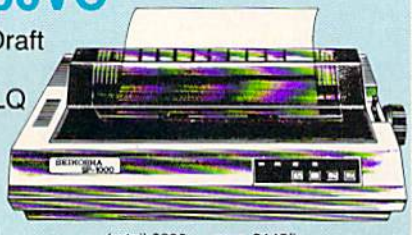

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Rhett Anderson
and David Hensley, Jr.

This handy utility offers a technique to let you flip sprites—including those in hi-res or multicolor—at machine language speed, while conserving memory often eaten up by sprite definitions. It can be used with sprites designed by "Sprite Magic" or other sprite editors. For the Commodore 64.

Sprites are a unique and very important graphics feature of the 64. They allow programmers to achieve animation with relatively little work. There are many good sprite editors available, including "Sprite Magic," found elsewhere in this issue.

Sprite Magic allows you to flip sprites both vertically and horizontally. Thus, it's possible to generate four different sprite definitions from one pattern. This feature of Sprite Magic was used often while designing the sprites in "Basketball Sam & Ed," which appeared in last month's issue. If you watch the basketballs closely while they are spinning in the air, you'll notice that there are four different views. Only one of them was drawn, and the Sprite Magic commands were used to generate the rest.

The problem with using many sprite definitions is the amount of memory that they consume. Each definition consists of 64 bytes (only the first 63 bytes actually contain sprite data, but the definitions are stored in 64-byte blocks because it's more convenient for the computer to deal with data in groups of 64 bytes). This means that four definitions would take up 256 bytes—more than can be held in a single disk block. It's even worse when you store the pattern in BASIC DATA statements; in that case, four definitions might take up more than four disk blocks.

"Sprite Flip" allows your program to flip sprite definitions at machine language speed. Thus, it gives you a nice choice: You can have a smaller program or more sprite definitions. Sprite Flip flips both hi-res and multicolor sprites. (Sprite Magic changes the colors of multicolor sprites during horizontal flips.)

Typing It In

Program 1, Sprite Flip, is a BASIC program which POKEs a machine language program into memory. Type it in and save a copy to tape or disk. To insure accurate entry, use the "Automatic Proofreader" program found elsewhere in this issue. Program 1 must be loaded and run before you use it in your own programs. Alternatively, you can merge it with your own programs.

We've included a demo, Program 2, to show how easy it is to use Sprite Flip in your programs. Type it in and save a copy. Before you run it, Sprite Flip must be installed by running Program 1.

The demonstration program displays two expanded sprites on the screen—one in hi res, and the other in multicolor. Press H to flip both sprites horizontally. Press V to flip them vertically.

In Your Programs

To flip a sprite under program control, follow this procedure:

- Make sure that Sprite Flip has been installed.
- POKE the sprite block number into location 781. This number can range from 0 to 255. In the demo program, block numbers 13 and 14 were used. (The sprite block is the memory location where the sprite definition begins, divided by 64.) Note that Sprite Flip only works on sprites in video bank 0—the VIC chip's default setting.
- For a horizontal flip, SYS 49152. For multicolor sprites, use SYS 49155.
- For a vertical flip—in either hi res or multicolor—use SYS 49158.

Sprite Flip can be used in two ways. First, you can put the same sprite definition into four different sprite definition blocks and use Sprite Flip to flip the second and fourth ones horizontally and flip the third and fourth ones vertically. This allows you to create animation by changing sprite pointers—the fastest and most versatile way to use Sprite Flip. This technique was used in Basketball Sam & Ed.

If you don't have many sprite definition blocks available, you can use Sprite Flip in realtime, flipping the definitions whenever you need to. The Sprite Flip Demo uses this method—there is only one sprite definition for each sprite. The sprite definitions are flipped upon demand.

The ML program resides in memory from 49152 to 49329. In addition, it uses about 70 bytes of memory directly after the program as a work area.

See program listings on page 92.

All programs listed in this magazine are available on the GAZETTE Disk. See details elsewhere in this issue.

Sprite Stamp

Bennie J. Montoya

It's never been easier to draw detailed hi-res pictures. This program lets you "stamp" your own sprite definitions—including those designed with "Sprite Magic"—onto the hi-res screen. For the Commodore 64 with a disk drive and one joystick.

"Sprite Stamp" is a computer drawing program with a new twist—you draw with detailed sprite "brushes." It's a clever way to create complex and detailed hi-res screens.

Typing It In

Sprite Stamp (Program 1) is written in machine language, so it must be entered with the "MLX" machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for the starting and ending addresses for the data you'll be entering. For Sprite Stamp, respond with these values:

Starting address: C000
Ending address: CA5F

After you have entered all the data from Program 1, be sure to save a copy of the program before exiting MLX. Don't try to run Sprite Stamp yet. You first need some sprite shapes to use as stamp patterns.

Program 2, "Starter," is a BASIC program that allows you to load and save the high-resolution screen images you create with Sprite Stamp. You can use Sprite Stamp without Program 2, but without Program 2 you won't be able to save or modify your designs.

Before you begin working with Sprite Stamp, you must create at least one set of sprites for stamp patterns. You can create them by hand if you like, but the easiest way to design the patterns is with a sprite editor like "Sprite Magic." If you use Sprite Magic, create DATA statements from your sprites beginning at line number 50. When you've finished making the sprite data, exit Sprite Magic and type LIST. You should see the DATA statements generated by Sprite Magic. If there are no DATA statements, return to Sprite Magic by typing SYS 49152 and try again. Once you're sure that the DATA statements are in memory, add the lines shown as Program 3. Then save the resulting program to disk.

If you create your sprites by hand, you'll have to create the DATA statements yourself. Use Program 3 as a skeleton. Begin numbering your DATA lines at 50.

Designing sprite shapes requires one special consideration. Sprite Stamp includes a Rotate command that allows you to turn the pattern in 90-degree increments. Since sprites are 24 pixels wide but only 21 pixels high, you should leave the rightmost three columns of pixels in the pattern blank. (That is, limit your sprites to 21 × 21 pixels.) If you use the full width of the sprite, the rightmost columns of the pattern will be lost when you use the Rotate command.

You can make several different sets of sprites and save each set to disk with a different name. For instance, you might have a set with electronic symbols, and then use those symbols to design circuits. Another set could be made up of clowns and tent sections to make circus scenes.

Getting Started

Follow this procedure to use Sprite Stamp:

- Load your sprite data program (Program 3 with DATA statements added).
- Type RUN to put the sprite pattern information into memory; then type NEW.
- Load Sprite Stamp (Program 1) with a statement of the form

```
LOAD "SPRITE STAMP",8,1
```

- Type NEW.
- To start Sprite Stamp directly, use a statement of the form

```
SYS 49152,n
```

where *n* is the number of different sprite patterns in your sprite data program.

- To use the Starter program, which allows the loading and saving of Sprite Stamp screens, load Program 2 with a statement of the form

```
LOAD "STARTER",8
```

- Replace the variable S in line 100 with the number of sprite patterns in your sprite data program.
- Type RUN. You'll be asked if you want to load a previously created picture file. If you answer *Y*, you'll be asked for the name of the file. If you answer *N*, you'll proceed directly to the drawing program.

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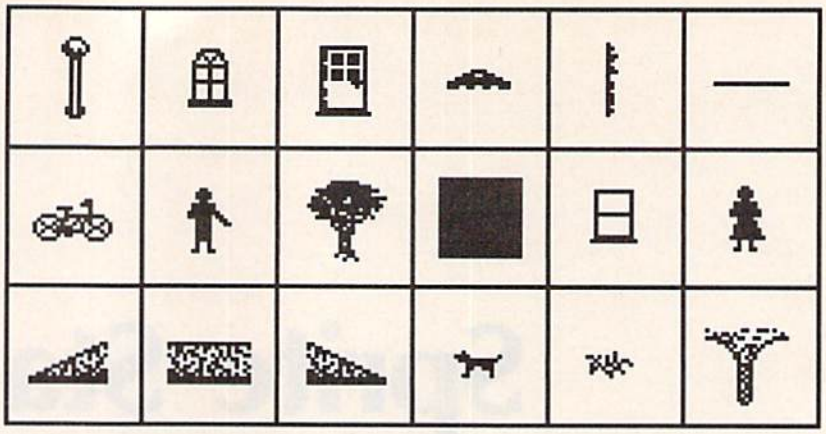
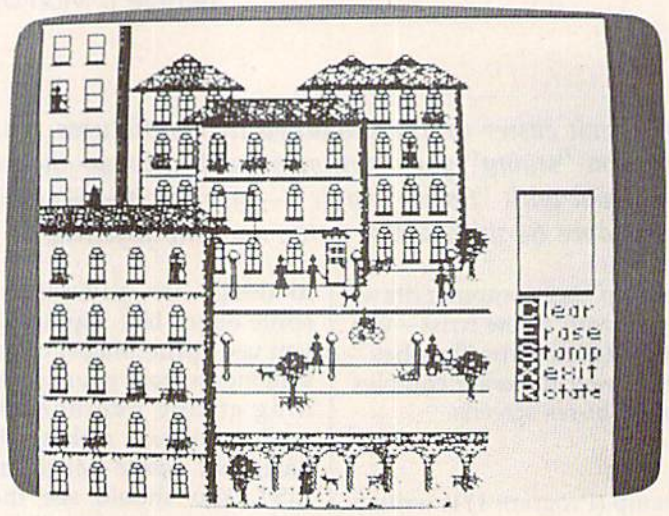




This detailed Commodore 64 hi-res screen was created by the 18 sprites shown above using "Sprite Stamp."

Sprite Art

It's easy to create pictures with Sprite Stamp. Use the joystick (plugged into port 2) to control the rectangular cursor. The following keyboard commands are used with the program:

C	Clear screen
B	Change background and drawing colors
X	Exit
S	Set stamp mode
E	Set erase mode
R	Rotate
space	Change sprite patterns

Unless you loaded a previously created screen, you'll probably want to begin by pressing C to clear the drawing screen. The current stamp pattern is shown in a window on the right side of the screen. Press the space bar to cycle through the available shapes. (The program cycles through the number of patterns you specify in the SYS statement that starts Sprite Stamp, so be sure to use the correct number.)

When you press S (for Stamp), the current shape is put down in the drawing color at the position indicated by the drawing cursor. When you press E (Erase), the pattern is put down in the background color. Press R (for Rotate) to rotate the pattern by 90 degrees.

To exit from Sprite Stamp, press X (and then RETURN). If you entered Sprite Stamp using the Starter program, you'll be given the opportunity to save the screen you just created (you'll be asked to give the picture a filename). If you don't wish to save your picture, press RETURN alone to exit the program. Otherwise, type a name for the file in which your screen image will be saved.

The hi-res screen used by Sprite Stamp is located in memory at locations 8192–16191.

See program listings on page 76.

Multisprite

John Augustine

Easily combine up to eight sprites to make larger, more realistic images on your 64 with this machine language enhancement to "Sprite Magic." A disk drive is required.

Although the "Sprite Magic" sprite editor makes sprite design easy, it is lacking one potentially useful feature: the ability to combine two or more sprites to make a larger sprite. Many recent commercial games have used this technique with great success. For example, some games use one sprite for a head and torso, and another for legs and feet. Dragons and snakes can be made by putting two or more sprites together horizontally, and hi-res sprites of more than one color can be made by overlaying two or more sprites.

"Multisprite" wedges into Sprite Magic, providing all the additional tools that you'll need to design images made of multiple sprites.

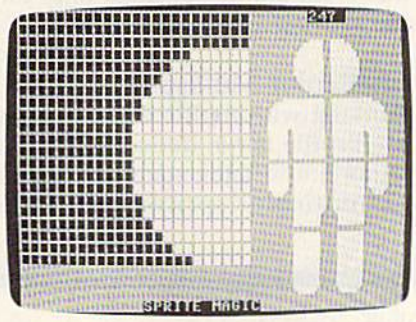
Typing It In

Multisprite consists of two programs. Program 1, the main program, is written in machine language. Type it in with the "MLX" machine language entry program located elsewhere in this issue. When you run MLX, you'll be asked for the starting and ending addresses of the data you'll be entering. For Multisprite, respond with these values:

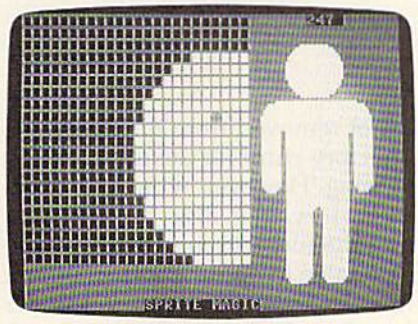
Starting address: 8000
Ending address: 846F

When you've finished typing in the program, be sure to save a copy to disk before leaving MLX. When saving the program, use the name MULTISPRITE.

A boot program is also included. Type in Program 2 and save it to disk. This program loads both Multisprite and Sprite Magic. For everything to work together, the boot program, Multisprite, and Sprite Magic must all be on the same disk. Program 2 expects the Multisprite program file to be named MULTISPRITE and the Sprite Magic program file to be named SPRITE MAGIC. If this is not the case, either rename the programs or change the names in lines 20 and 40 of Program 2.



All eight sprites are being used to create a giant man.



The sprites have been moved closer together, joining all eight into one multisprite.

Getting Started

Multisprite is an extension of Sprite Magic, so if you're familiar with the operation of Sprite Magic, you'll feel right at home with Multisprite. If you're unfamiliar with Sprite Magic, it's best to learn how to use all of the features of that program before trying to use Multisprite. All of Sprite Magic's features work as intended when you're using Multisprite.

Let's draws a sample multisprite. First, load and run the boot program. Sprite Magic and Multisprite will be loaded and you'll see the familiar Sprite Magic screen. Go to sprite definition 150 (travel through the definitions by using the + and − keys.) You'll eventually want to position your sprites on the Sprite Magic screen, and you can make this task much easier by turning on all the pixels in the sprites. This is best done by pressing SHIFT–CLR/HOME and then CTRL-R. As many as eight sprites may be combined into one multisprite. You'll use two sprites in this example, so go to sprite 151 and repeat these keystrokes.

The program must keep track of which sprite is the "start" sprite. To select sprite 150 as the start sprite, move to that pattern and press the British pound key (£).

Your next task is to position your sprites on the Sprite Magic screen. Sprite Magic normally shows only one sprite on the screen, so it's natural that it always puts it in the same place. But Multisprite can move its sprites so that you can make horizontal multisprites, vertical multisprites, or overlayed sprites.

When you pressed the £ key,

the screen color should have changed to yellow. This means that Multisprite is ready for a command. To make it easy to reference the various sprites, Multisprite numbers its sprites beginning at 0. Since you are using two sprites, beginning at 150, Multisprite refers to sprite definition 150 as 0 and 151 as 1. When you give Multisprite a sprite number as a command, it lets you position that sprite. Press 1 and use the cursor keys to move sprite 1 next to sprite 0. The screen turns purple to show that you can move the sprite. When you're satisfied with the relative position of the sprites, press RETURN. Multisprite is ready for another command. If you were working with more than two sprites, you would position them all before continuing. Press RETURN to leave Multisprite mode and enter Sprite Magic mode. (Your screen should turn gray.)

Now use Sprite Magic's editing features to design your multisprite, flipping between sprites 150 and 151 as needed. Both sprites will be displayed at all times. The first thing you might want to do is clear the sprites with SHIFT-CLR/HOME.

When you've finished editing your multisprite, go back to the start sprite and press £. Then press SHIFT-CLR/HOME. This will *not* clear the sprite. It simply resets the Multisprite parameters. You are now free to go to another sprite definition area and draw another multisprite.

Multisprite also allows horizontal or vertical expansion of the sprites. Simply move to the starting sprite in the multisprite and press £ and then X (for horizontal expansion) or Y (for vertical expansion). Note that you cannot expand individual sprites within a multisprite; all the constituent sprites will be expanded, and the expansion command should be specified only for the starting sprite of the group.

Multicolor Multisprites

Working with multicolor sprites in Multisprite is not difficult, but it is important to understand the basics of multicolor sprites before attempting to design one.

In multicolor, all sprites share the same colors. The lone exception to this is the color obtained by pressing the 3 key in Sprite Magic (which is actually color 2—binary bit pattern 10). Each sprite may have a different color for this bit pattern. When working with Multisprite, you must set key color 3 separately for each sprite in your multisprite.

Note that you cannot specify multicolor for individual sprites within a multisprite. When you're designing a multicolor multisprite, all the constituent sprites must be designed in multicolor mode.

In Your Own Programs

Once you've designed your multisprite, you'll want to use it in your own programs. If you are familiar with programming sprites, this should be no problem. The important thing to remember is that each multisprite is still made up of more than one sprite. Whenever you move a multisprite, you must move every sprite that comprises the multisprite.

See program listing on page 84.

bug-swatter

Modifications and Corrections

• "Directory Filer Plus" (June) contains a bug in the Insert Divider function. If, for example, your directory looks like this:

```
PROGRAM 1
PROGRAM 2
PROGRAM 3
PROGRAM 4
```

attempting to insert a divider between Program 1 and Program 2 will modify the directory as follows:

```
PROGRAM 1
---------------
PROGRAM 3
PROGRAM 4
PROGRAM 4
```

Program 2 is lost and Program 4 appears twice in the directory. *Do not* save the directory back to disk by pressing f1; doing so effectively erases Program 2 from your disk. If you do save the corrupted directory to the disk, the data from Program 2 is not removed from the disk—the directory entry for the file is simply missing. However, without a directory entry, the disk drive cannot find the file, and therefore you will be unable to access the data in that file. To correct the Insert Divider function, change the STEP value in line 1000 from 1 to −1:

```
1000 N=N+1:FOR X=N TO F+1 STEP-1
```

Retrieving a missing file is much more difficult. A file whose directory entry has been erased by the faulty Insert Divider function can be recovered if no other files have been saved to the disk since the file was lost. The easiest way to recover the missing file is to validate the disk (do not use the normal Commodore Validate command on a disk that includes *GEOS* files) and use a program like VIEW BAM from the 1541 TEST/DEMO disk that came with your disk drive to find the unused sectors on the corrupted disk. Then, using a disk sector editor, search the unused sectors on your disk for the deleted file. When you find the missing file, you must rebuild the directory entry manually. Make sure you validate the disk again when you finish (again, do not validate a *GEOS* disk using the regular Validate command). The manual that came with your 1541 contains information on how directories are constructed that will help you in rebuilding the entry. This is not a procedure that should be attempted by a novice. If you absolutely must recover the lost file, copy the corrupted disk to another disk, and work on the copy.

The problem with Insert Divider exists only in the printed magazine version; the version on the Gazette Disk is correct.

80-Column Disk Sector Editor
For The 128

Matthew Desmond

Inspect and alter information anywhere on a disk with this exceptionally high-quality sector editor. An 80-column monitor is required.

One of the most valuable tools a programmer can have is a sector editor. With it, he can inspect every nook and cranny of a disk and change anything he likes—it's even possible to peruse the contents of files that have been deleted but have not yet been overwritten.

"80-Column Disk Sector Editor" is arguably the best disk editor we've published to date. Its 80-column screen lets you see all the information at once—which sector and track you're on, the entire sector in both hex and character representation, and a menu of commands. And it's all color-coded to help you find the information you need. In addition, all of the available commands are displayed constantly in a menu at the bottom of the screen.

Typing It In

Disk Sector Editor is made up of three programs. The first is written in BASIC. It adjusts BASIC pointers to reserve memory for the machine language portion of the program. Type it in and save a copy to disk.

The second program is also written in BASIC. Type it in and save it with the name SECTOR .BAS. Since this program tries to load Program 3, do not attempt to run it at this point.

Program 3 is written entirely in machine language, so you must enter it using the Commodore 128 version of the "MLX" machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for the starting and ending addresses for the data you'll be entering. For Program 3, respond with the following values:

Starting address: 1D00
Ending address: 2127

When you've finished typing in the data, be sure to save a copy to disk before leaving MLX. Use SECTOR.ML as the filename—Program 2 looks for a file with that name.

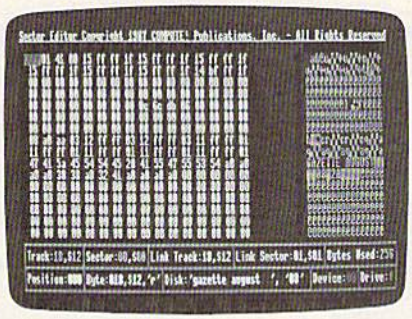
Using The Program

All three programs must be on the same disk in order for 80-Column Disk Sector Editor to work. Be sure you're in 80-column mode. (Disk Sector Editor does not produce a display in 40-column mode.)

Load and run the boot program (Program 1). This program loads Program 2 (SECTOR.BAS), which in turn loads Program 3 (SECTOR .ML). The sector editor screen should appear.

A disk block (also known as a sector) is made up of 256 bytes. A byte can hold an integer value in the range 0–255 (00–FF in hexadecimal) or one ASCII character. The bulk of Disk Sector Editor's screen is made up of two charts. The largest of these gives the hexadecimal equivalent of each number in the current block. The other chart holds the Commodore ASCII equivalent of the number. You can use these charts interchangeably. In some cases, the textual display is more useful. In others, you'll prefer the numeric display.

Several boxes below the charts hold useful data, some of which is extracted from the current block. The first two, Track and Sector, hold the track number and sector number of the current block. Link Track and Link Sector hold the link block of the current block. These values are valid only within files. A file which is longer than one disk block may not necessarily go into consecutively numbered sectors. The link information provides a "thread" the system follows when it loads or reads a file. The link information is stored in the first two bytes of the block.



Examine every sector of your disk with this powerful utility written to use the 80-column capability of the 128.

Other boxes hold the number of bytes used in the block, the position of your editing cursor, the value of the byte under the cursor (given in hex, decimal, and character representations), the disk name and ID, the device number, and the drive number.

At the very bottom of the screen, in red, is a menu of the commands. Not all of the commands are visible at once. Press N (next menu) to see the remaining commands. If a disk error occurs, the menu will disappear and an error message will appear. Press any key to get back to the menu.

The commands are as follows:

- **+** Display the next higher block.
- **B** Select a new block to display. You will be prompted for the track and sector number.
- **@** Enter a new value for the hex number at the current cursor location within the sector. Note that the change will not be saved to disk unless you use the W (write sector) command.
- **#** Select a new drive.
- **W** Write the current block to disk. Be very careful with this command.
- **–** Display the next lower block.
- **L** Display block pointed to by the link information in the current block.
- **T** Input new text at the current cursor position within the sector. Press RETURN when you've finished. The change will not be saved to disk unless you use the W command.
- **D** Select a new device number.
- **S** Send disk command to the drive.
- **F** Format a disk.
- **Q** Quit 80-Column Sector Editor.
- **C** Display a catalog of the disk.
- **E** Exchange disk. Allows you to inspect a different disk.
- **M** Move block. You will be prompted for a new location for the information in the block.
- **N** Display the alternate menu.

For all commands which prompt you for more information, such as a track or sector number, you can press the ESC key to cancel the command and return to the main menu.

Disk Structure

Sector 0 of track 18 holds the block availability map (BAM) for the disk. Bytes 0 and 1 of this sector point to the first block of directory entries. Bytes 144–159 hold the disk name padded with shifted spaces. Bytes 4 through 143 hold the actual BAM. Each bit in each byte holds the status of a sector (whether or not it is available for use). Interpreting the BAM is a difficult and technical subject beyond the scope of this article, so a reference book which covers the inner workings of Commodore disk drives is almost a necessity when working with a disk at this level.

Let's take a look at the disk directory. Go to the first sector of the directory (pointed to by bytes 0 and 1 of track 18, sector 0; normally sector 1 of track 18). In the ASCII chart for the directory sector, you'll see eight filenames (assuming you have at least eight files on your disk). The two numbers immediately preceding the filename give the starting track and sector numbers for the file. The number preceding those numbers gives the file type. An $80 represents a deleted file. If you've accidentally scratched a file, changing this number to $82 (PRG) or $81 (SEQ) will recover it, assuming that you haven't saved any more files to the disk since the accidental deletion. To permanently protect the file, the BAM must be changed to reflect the sectors in this file as being in use. This is often more trouble than it is worth. A better solution is to validate the disk at this point. This will let the disk drive set up the BAM to match the directory. Another solution is to go to BASIC, load the newly recovered program, save it to another disk, and then go back with the sector editor and again mark the file for deletion.

Sector editors can be as dangerous as they are powerful. The safest route to follow is to make changes on a duplicate copy of the disk. At the very least, make copies of all the irreplaceable files on a disk before using any sector editor.

See program listings on page 84.

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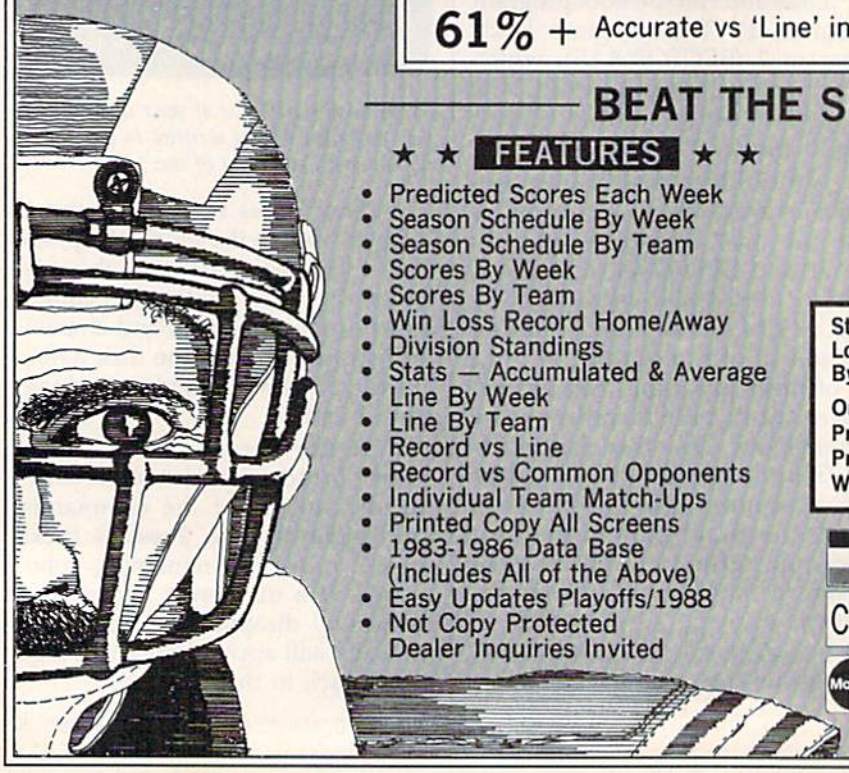

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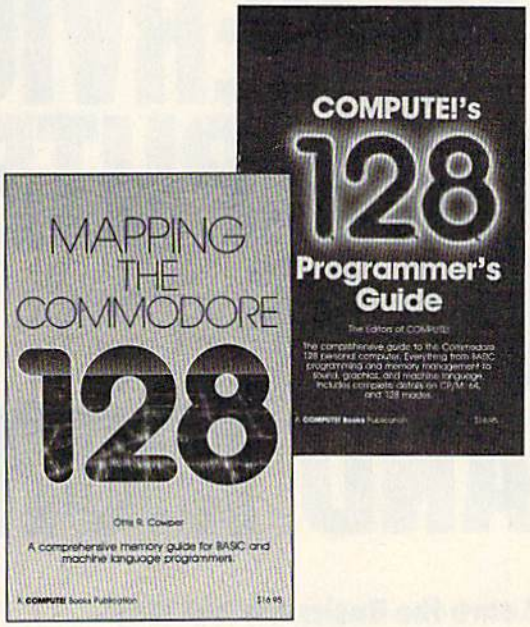

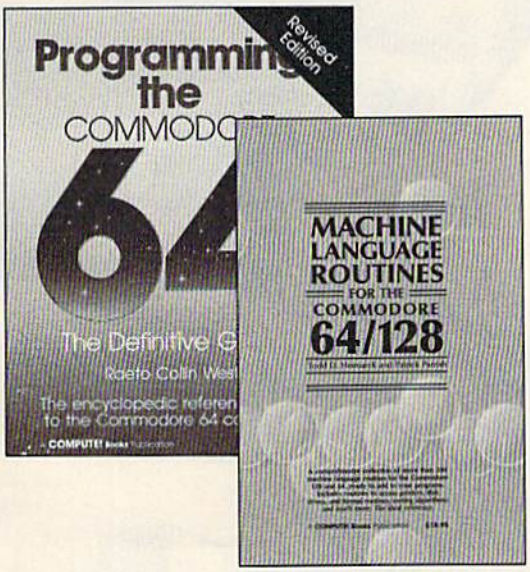

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Dynamusic

Roger Speerschneider

This set of programs will help you create music that plays in the background while a program is running—music that sounds as good as the songs played in commercial games. For the Commodore 64. A disk drive is required.

Trying to write music in BASIC can be a frustrating experience. There are many problems to solve. It is nearly impossible to turn the three voices on or off at the same time. Storing notes in DATA statements uses up too much memory. If you do manage to get the song to sound the way you want it to, you've exhausted a great deal of time and effort.

"Dynamusic" is a solution to this problem. You can create compact music files that play in the background of BASIC or machine language programs. All you need to do is start the music—the song will even play over and over if you choose.

Dynamusic itself is broken up into two programs. The first, written in BASIC, is the "Dynamusic Translator." This program lets you enter the notes, one at a time, into the computer. The second program, "Dynamusic Player," is a machine language program that plays music constantly, even when you edit, LIST, or RUN other programs. It can be quite eerie to listen to music as you type in a program.

Type in Program 1, Dynamusic Translator, and save it to disk. Then type in Program 2, Dynamusic Player. Since Program 2 is written entirely in machine language, you must enter it with "MLX," the machine language entry program located elsewhere in this issue. When you run MLX, you'll be asked for a starting address and an ending address for the data you'll be entering. For Program 2, respond with the following values:

Starting address: 9E00
Ending address: 9F97

Before leaving MLX, be sure to save the program to disk.

Two other programs have been included. Program 3, "Dynamusic Customizer" (a BASIC program), allows you to change the operating parameters of the SID chip to make the music sound exactly as you like. Type it in and save it to disk.

Program 4 isn't really a program; it's a music file of the type created by Program 1. This short piece will show the potential of Dynamusic. The tune, "Elite Demo," is adapted from the "Elite Syncopations Rag" by Scott Joplin. You must enter the data from Program 4 with MLX. However, you must make a slight modification to MLX before you begin to enter this data.

To conserve memory, Dynamusic stores its music data in the RAM under BASIC ROM. This area of memory is rarely used by BASIC programs, and by only a few other machine language programs. Because of this, MLX was designed to reject starting or ending address values in this range. To persuade MLX to accept the data from Program 4, you must *temporarily* disable MLX's address-checking feature. Replace the current line 1040 of the MLX program with

```
1040 GOSUB 1080:F=0:RETURN
```

Remember, this is just a temporary patch to enter Program 4; it is not a correction to MLX.

Once you have changed the MLX program, run it and enter the following address values when prompted:

Starting address: A000
Ending address: A17F

Then enter the data from Program 4. Be sure to save a copy before exiting MLX. You'll learn later how to play this file and the song files that you create.

Entering A Song

Load Program 1, the Dynamusic Translator. List line 20. It reads LN=8000. The value of LN specifies the line number where your music will be stored in DATA statements. After you enter your song, you'll be able to see the data for your song by typing LIST 8000–.

Type RUN and then sit down at the computer with your sheet music. Since the SID chip has three voices, all of which can produce a note at the same time, you must enter a note or rest for all three voices. If you want only one voice to play, you must enter a rest for the other two voices. As an example of how to enter music, let's enter a C-major chord made up of three half notes. First, give the octave for the first note: *4* (the fourth octave of C on a piano is middle C). Then, give the first note: *C*. Then the duration: *2*, for a half note. Press RETURN to enter the note. A DATA statement will be made and appended to your program.

Enter the next two notes, an E and a G, both in octave 4, both half notes. Sharps and flats can be specified when entering the note value by adding an *S* or *F*, respectively. For example, enter AS for A-sharp, BF for B-flat.

Rests can be entered by pressing *R*. The duration of the rest must then be specified.

It's possible to dot a note when you enter the time. Just put a period after the time value. For instance, 2. is a dotted half note. A dotted note in Dynamusic plays half again as long as a normal note.

The *D* option on the timing screen allows you to handle unusual note timing. Duration values

must be whole numbers.

The review screen allows you to review your entry. If you decide the note is wrong, press *E* to erase the note and try again. By typing *R* here you can add a remark. I recommend that you mark the end of each measure to ease later editing.

It's important to make sure that all three voices remain synchronized with each other. If one voice gets ahead of or behind the others, they will remain that way for the entirety of the song.

If you become weary, press RUN/STOP and save Dynamusic Translator (with its new DATA statements) to disk with a different name. Later, to resume music entry, load the program and change LN in line 20 to a value larger than the number of the last current DATA line.

When the music is complete, enter *Q* (for quit). Choose between *cycle* and *end*. Cycle forces the music to play over and over. End causes the song to play through only once.

Next, you are asked to enter a number to determine the tempo (the rate of play) of the music. Each note duration is multiplied by this number, which may be a decimal value. The smaller the number, the faster the music will play. A value of 1 always works. Tempo values of 0.5, 0.75, 1.25, and 1.5 work as long as you haven't specified any unusual durations with the *D* command.

Storing Music Data

Now decide where you would like to put the music data. Unless you specify another area, the data will begin at location 40960. On the 64, that is the beginning of a 12K area of free RAM. The first 8K of the area (locations 40960–49151) is hidden beneath BASIC RAM and isn't normally used. The last 4K (locations 49152–53247) is heavily used for machine language programs. Another 8K of memory is available beginning at location 57344. Do *not* attempt to store music data in the 4K block from 53248–57343. *Any chosen starting location must be a multiple of 256 and not less than 2048.*

After Dynamusic Translator POKEs the music data into memory, it asks whether you also want it saved to disk. If you do, answer *Y* and give a filename. It's a good idea to also save a working copy of the entire Dynamic Translator program—including your song data. That way, you'll be able to change the DATA statements if the song doesn't sound right.

The First Performance

If you've just entered your music, and it has been sucessfully POKEd into memory, load Dynamusic Player (Program 2) with a statement of the form

```
LOAD"PLAYER",8,1
```

If you want to listen to music in a file which has been saved—for example, Elite Demo (Program 4) or a song you created—first load your song with a statement of the form

```
LOAD "SONG",8,1
```

Then load and run Program 2.

Type NEW. If your music data does not begin at location 40960 (the default address), Dynamusic Player must be informed of the change. POKE the value of the new starting address divided by 256 into location 40780.

If you're going to run a BASIC program, you should protect Dynamusic Player from BASIC. Do this by starting and stopping the music before loading the BASIC program, or by typing

```
POKE 56,158:CLR
```

(You can also include this as the first line of the BASIC program you want to run.) You may now load your program.

To start the music, execute the statement SYS 40448 either within your program or from direct mode. To stop it, execute the statement POKE 40448,0. Be sure not to restart the music when it's already playing, and don't try to turn it off when it's already off. Also, do not play music during disk access. (If your program accesses the disk drive, turn off the music before disk access. You can restart it after all disk operations are completed.)

Customizing The Sound

When the music starts (and every time it repeats), the registers of the SID chip are filled with values from a group of *shadow registers* at locations 40809–40833. Each SID register has a shadow in this range. For example, the voice 2 attack/decay register is located at address 54284, the 12 locations beyond the address of the first SID register. Thus, the shadow voice 2 attack/decay register is located at address 40809 plus 12 (40821).

By changing the values in these locations, you can change the way your songs sound. (You'll need a reference book which explains the SID chip. Also, if you are new to programming music, see "Exploring the SID Chip" elsewhere in this issue.) Just POKE values into the shadow registers as your music plays. The next time the song repeats, you'll hear the effects of your changes. When you're satisfied with the sound, you can save the altered Dynamusic Player. This modified version of the program will play all songs with your new parameters. When you're ready to save Dynamusic Player, stop the music, load and run Dynamusic Customizer. When the program asks for a filename, type in the name that you would like to use for the customized version of Dynamusic Player.

Selective Deletion

The SID chip cannot play more than three notes at once. If the music calls for more than three notes, you must decide which note or notes to leave out. Notes exactly one octave up or down from another note are good candidates for deletion.

Dynamusic can be tuned (changed in pitch) like a musical instrument. Line 400 of Dynamusic Translator (Program 1) contains an expression that controls the tuning of the music. The first value in the expression determines the frequency (in cycles per second, or *hertz*) of the base note of the tuning scale. The current value, 440 hertz, is a natural A. If you change the 440 to another value, all other notes in the scale will be altered correspondingly to remain in tune with each other.

It is possible to change tunes while Program 2 is playing. Your program can POKE a new value into the music pointer address, location 40780. The next time the music starts or is cycled, a different song will play. The number to POKE into this location is the starting address of the song data divided by 256.

See program listings on page 90.

Commodore Relative Files: Defensive Programming

Jim Butterfield, Associate Editor

Relative files are a good way to store data for fast access. But many programmers have trouble using them. Here's how to write defensive programs which are likely to give you trouble-free relative files.

The idea behind a relative file is this: If you want to see or change record number 12, you go straight to that record—no need to plow through records 1–11, as you'd need to do with a sequential (SEQ) data file. Another advantage is that you don't have to make a new copy of the file when you want to change a record; the change is made by replacing the old data with the new.

How does this work internally? First of all, each record in the file has a fixed amount of space allocated. That way, when you change information in a record, the records that follow don't need to be moved. All the space that is allotted doesn't need to be filled. For example, you could allocate 120 characters per record, but some or all of the records might be smaller than that. The remaining unused space is padded with 0's.

The second part of the trick involves the use of an *index*. Whenever you specify a record you wish to access, the drive does some arithmetic and then checks the index (called a *side sector*) to see where on the disk your information is stored. (You don't need to know about the arithmetic; it's moderately complex.) If you just call for record 15, for instance, the disk drive calculates that for a 100-character record size it needs to fetch the sixth block from the file. It looks up the address (track and sector) of the sixth block in the side sector index, and then reads the appropriate block from disk. When the block has been read, the same arithmetic tells the drive to look at position 130 in that block for the start of the desired record. Again, you don't need to know how the drive does it. Just supply the record number and let it work.

There are inherent disadvantages in this scheme. Relative files are larger, slower, and more difficult to handle than sequential files. They are beset by pitfalls—things that can go wrong if you don't handle your coding exactly right. If you need to use relative files, this article will help steer you clear of the danger spots.

SEQ vs. REL

Consider the sequential (SEQ) data file. It is much simpler than a relative file, and can do most jobs at least as well. An old data processing axiom says: If a session calls for more than 15 percent of a file to be referenced, use a sequential file; if less, use a relative file. The point is that if you need to access only a small fraction of the file, why wade through the whole thing? In this case, a relative file will let you use only the parts you want. A sequential file, in contrast, needs to be read from start to finish, and an update requires that a new copy of the file be made.

There are other considerations. If a sequential file is very large (more than half the disk capacity), you don't have room to make a copy on the same disk. A relative file, which can be changed "in place," has a definite advantage here.

Here's one disadvantage of relative files that you should consider very carefully before deciding to use them for a particular task: If you change the contents of a record on a relative file, the old information is irrecoverably lost. A mistake at the keyboard could lose important information permanently. With sequential files, you update by copying everything over to a new file. The old file can be retained, allowing you to go back to earlier data and retrieve lost information.

Guidelines

The following guidelines are safety rules. You can sometimes get away with breaking them. Yet few of us like to take a chance of data being lost, so you might want to follow them religiously.

The demonstration program given below is intended to show many of the rules given in these guidelines. The program is written to run on any eight-bit Commodore computer.

Rule 1: Create enough records. When you first create a file, be sure to create enough records so that more than one block (254 characters) is used. For example, the demonstration program uses a record length of 33, and thus must create 8 or more records (254 / 33). In this case I created 10 (see line 140). It's a good idea to create a relative file with a special program. After a file has been been created, all following activity is updating. The demo program tests to see if the file exists, and if not, it creates it (the test is lines 40–70; the file creation is performed in lines 100–200). Note that

the program insists that the only acceptable error is number 62, File Not Found. Anything else is a "real" error and the program stops.

Rule 2: Always set the file pointer to the first byte of the record. Always position the pointer to the first character in the record. The last parameter in the P command should be CHR$(1). See lines 140, 330, and 480 of the demonstration program. Read or write the whole record each time to stay out of trouble.

Rule 3: Check the drive status. Always read the status from the disk drive after every positioning command. Even if you don't care what the drive status message says, reading the status information insures that the drive has had enough time to locate the position to the new record.

Lines 150, 340, and 490 of the demo program do this. It's interesting to observe that some errors are quite acceptable. For example, line 150 insists on seeing error 50; at that point the program is creating a file and knows that the record it has just called up does not exist. When status is checked at line 340, a No Record error tells the program that there are no more records to be read. And at line 490, the same error simply advises the program that the next record it writes will be a new one.

The important thing to remember is that reading the drive status after positioning is not just to check errors—it's for pacing the program so that data will not be rushed between computer and disk drive before the drive is ready.

Rule 4: Add 96 to the secondary address. It doesn't hurt to add 96 to the secondary address value in the P command. Note that the demonstration program opens the relative file with a secondary address value of 2 (line 50). But in the position commands on lines 140, 330, and 480, the value 96 has been added in to make 98.

Rule 5: Use one PRINT# per record. When you're writing to a file, use one PRINT# to write one record; no more, no less. You should write all the fields of the record in one shot. (If you use the less reliable practice of positioning within the record, you *can* write part of a record—but it's preferable not to).

Note lines 530–610. Even though we have several data fields within the record, they are concatenated (stuck together) in line 580. The various fields are separated by RETURN characters, but no RETURN is needed at the end of the record (line 600 trims off the last RETURN, and line 610 prints the record without adding a RETURN).

If multiple fields within a record interest you, examine lines 370–420, where the system status variable ST is used to detect whether there are more fields to follow within a record.

Large Leaps

If you are reading or writing records in strict sequence (1, 2, 3, 4...), the above precautions should be sufficient. If you're hopping around, here are two more rules:

Rule 6: Position twice for input. If your program is *reading* records out of order, give the position (P) command twice. Get the drive status message each time.

Here's the problem that necessitates this strange procedure: To position to a new record, the disk drive may need to bring in new blocks. First, it must check the side sector index for the new block desired. If the new record is far away, it may need to read in a new side sector. Finally, it must bring in two data blocks before it's ready to supply data to you. That can take quite a while, and a second positioning can give the drive a chance to catch its breath.

The demonstration program does not do double positioning. It doesn't need to, since it reads the records in sequence.

Rule 7: Close and reopen for output. If your program is *writing* records out of order, the safest thing to do is to close the file after each write. You may then immediately reopen it (after reading the drive status). It may cost over a second in running time to close and reopen the file, but this procedure offers increased insurance against corrupting data on the disk.

When writing records, the drive has a huge amount of work to do. The drive doesn't write to disk at the time you give the PRINT# command; rather, it waits until a position command tells it to move somewhere else. The drive must then safely store all the changes it has made before it can read in the new data. This is a ticklish time—it's possible that the computer may try to pour in more information before the drive is ready for it.

The safest procedure is to close and reopen the file, and that's what our example program does in lines 640–670. This is probably overkill under these circumstances, since the drive will have a lot of time to do its work while the user is typing in the next record. But when it's your data—safety first.

Other Relative File Anomalies

Commodore data files shouldn't normally contain characters with ASCII codes 0 or 255. If you try to include these two characters in a record, you'll probably cause problems.

Character 0 is used pad out the unused part of each record. If you write this character to a relative file, the drive will not know where the record ends, or which part is full. So don't write CHR$(0).

Character 255 is used by the operating system to indicate an empty record—one with no data. Our demonstration program used it to write an empty record during file generation (line 170), and later detected this value to report an empty record (line 380). If you want to use this character, be careful.

You can't generate a relative file with record lengths of 42, 58, or 63 characters. It's just an oddity of the disk operating system that these values are forbidden.

The 1571 is one of Commodore's most recent disk drives, designed especially to work with the Commodore 128. However, for the standard double-sided 128 format, the operating system code to control reading and writing on side 2 is currently bug-ridden and almost useless. Commodore will be releasing a new 1571 ROM to correct the problems; it should be available by the time you read this. Until that happens, it's wise to leave two-sided disks half-empty when using relative files.

Relative files demand extra care. But if you know the rules on how to code defensively, you can make them behave as they should.

See program listing on page 78.

BASIC for beginners

READ And DATA—Two Of A Kind

Larry Cotton

Last month we wrote a state capitals drill program which illustrated some of the BASIC commands we've learned. However, because we used only the BASIC commands we've covered so far in this column, the program wasn't very elegant. This month we'll delve into two extremely useful statements—READ and DATA—which will ultimately allow us to modify and greatly shorten the program, depending on how many drill questions we want to ask. In the process, we'll add just the touch of elegance we need and, as a bonus, make the program easier to understand.

Before we modify the program, let's go over a few basics. If you understand these examples without entering and running them, that's fine. But if you don't understand a certain example, it would be a good idea to type it in, run it, and observe the results.

Reading Strings

READ and DATA work together; if you use the READ command, there must be some DATA to read. Their purpose is best illustrated by studying a simple case which uses a string variable:

```
10 READ A$
20 DATA RALEIGH
30 PRINT A$
```

If you run this, READ in line 10 causes the computer to look for a DATA line. It finds the data at line 20—the word Raleigh—and line 30 prints it out. We could have accomplished the same results with the following:

```
10 A$="RALEIGH"
20 PRINT A$
```

So why use READ and DATA? This simple case, for demonstration purposes only, shows how READ and DATA work; in actual practice these commands are used when many pieces of data are to be read.

Reading Numbers

READ also works with numeric variables:

```
10 READ A
20 DATA 1000
30 PRINT A
```

This time, the variable A is assigned the first (and in this case only) DATA element, 1000; line 30 prints it on the screen.

Reading More Than One Piece of Data

Now let's illustrate how to read more than one piece of data with the same command:

```
10 READ A$, B$
20 DATA RALEIGH, RICHMOND
30 PRINT A$
40 PRINT B$
```

Line 10 READs *both* pieces of data before going to line 30. Punctuation is very important when entering these statements. Note that the variables A$ and B$—and the data that will be assigned to them—are separated by commas. A frequent error is to put a comma after the word DATA—don't do it. Also be sure not to put an extra comma after the last data element. And check that your commas really aren't periods. Because the period and comma keys are side by side on the keyboard, it's easy to mistakenly type one for the other.

It's very important that you have enough data to be read. Look at this:

```
10 READ A$, B$, C$
20 DATA RALEIGH, RICHMOND
```

If you run this, you get one of BASIC's error messages—?OUT OF DATA ERROR IN LINE 10. The READ statement in line 10 tries to read three pieces of data but finds only two. Note that the line mentioned in the error message is the line that's *reading* the data, not the DATA line itself.

Using FOR-NEXT With READ And DATA

Often, a FOR-NEXT loop is used to read data:

```
10 FOR T=1 TO 5: READ X
20 PRINT X
30 NEXT
40 DATA 5, 10, 15, 20, 25
```

Now you can begin to appreciate the value of READ and DATA. The alternative to this would have been to make X = 5, then 10, and so on to 20, printing out each value. Be sure you have as many pieces of data as the number of times the FOR-NEXT loop increments.

One of the more common uses for reading data is to put values into certain memory locations, or registers, in the computer that aren't normally found there. The BASIC command POKE is used to do that:

```
10 FOR L=49152 TO 49157
20 READ D
30 POKE L, D
40 NEXT L
50 DATA 169, 1, 141, 32, 208, 96
```

(Type this in only if you have a Commodore 64.) This little program demonstrates a very common technique for installing machine language programs in the computer. (Machine language programs run much faster than BASIC ones do; computer games, which usually need speed for good playability, are often written in machine language.)

Before this program is run, the memory locations could contain numbers in the range of 0–255. After it's run, the memory locations would be loaded with specific numeric data as shown here:

Location (L)	DATA (D)
49152	169
49153	1
49154	141
49155	32
49156	208
49157	96

The FOR-NEXT loop will increment six times; six memory locations will be affected. Again,

always make sure the number of data elements corresponds to the number of times the FOR-NEXT loop is to be executed.

Mixing Numeric And String Data

Numeric and string data can be mixed:

```
10 READ S, S$
20 DATA 4, LISA
30 PRINT "NUMBER";S;"IS ";S$
```

Data is read in the order in which it's requested. If a numeric variable is requested (READ S), a number must be the next piece of data to be read. Change line 20 to see what happens if they're switched:

```
20 DATA LISA, 4
```

Now, instead of an OUT OF DATA message, we get a SYNTAX ERROR message. Line 10 is expecting a number (S) as its first piece of data, but instead it gets a string. Note that the line referred to in the SYNTAX ERROR message is the DATA line. The line referred to in an OUT OF DATA message is the READ line.

Using GOTO With READ And DATA

GOTO is often used with READ and DATA. Later you'll see that this is the key to the rewrite of the state capitals drill program:

```
10 READ N$
20 PRINT N$
30 GOTO 10
40 DATA DAVID, MICHAEL, VICTOR,
   JIM
```

Lines 10 and 20 READ and PRINT the data. Line 30 sends control back to line 10, which, each time executed, READs a new piece of data. If you typed this one in and ran it, you saw the OUT OF DATA message after all the names were printed—there was nothing to limit how many times the computer executed GOTO 10.

Here's one way to eliminate the OUT OF DATA message when GOTO is used:

```
10 READ N$: IF N$="QUIT" THEN
   END
20 PRINT N$
30 GOTO 10
40 DATA DAVID, MICHAEL, VICTOR,
   JIM, QUIT
```

It would be a good idea to type this one in and run it. The computer READs (in line 10) the first name from DATA line 40 (DAVID) and prints it in line 20. Line 30 sends control back to line 10 for another read (MICHAEL) and so on until all four names are read and printed. The last time through line 10, the word QUIT is read as N$, the IF-THEN condition is satisfied, and the program ends. The word QUIT isn't printed.

For numbers, you can use a value not normally used by the program to stop the reading process:

```
10 READ N: IF N=-1 THEN END
20 PRINT N
30 GOTO 10
40 DATA 5, 10, 15, 20, 15, -1
```

Modifying The Drill Program

Now we've covered enough of the basics of READ and DATA to see how to modify last month's state capitals drill program. If you saved a copy of last month's program, just load it, type LIST, and change lines 140 and 150 as shown below. (If not, a complete listing appears at the end of this article.)

```
140 READ A$, S$: IF A$= "QUIT"
    THEN 5000
150 FOR I=1 TO 3: PRINT Q$;S$;"?"
```

Line 140 now expects to find two pieces of string data—A$ (the answer) and S$ (the state name). When it reads the word QUIT, control is sent to line 5000, the program-ending routine.

Line 150 is what will make our new program much more efficient (and elegant). Compare last month's program to this one and you'll see why.

Every time we asked a question we had to repeat a certain routine and each state's name, which used five lines. Now we simply use S$, which is read as the second piece of data.

As we saw in an example above, we send control back to READ more DATA by using the GOTO statement. Leave lines 160–180 as they are and change line 190 to

```
190 GOTO 140
```

Now erase your old lines 200, 210, 220 and 230 by typing those numbers and pressing RETURN. (You may recall that this is the way to erase BASIC program lines.) Leave the subroutines as they are in lines 1000–5000.

The only thing left to do is to add the data for line 140 to read:

```
500 DATA RALEIGH, NORTH
    CAROLINA, RICHMOND,
    VIRGINIA, QUIT, QUIT
```

Why two QUITs? Remember that line 140 expects two pieces of string data. The second doesn't have to be QUIT; this is just a common programming technique.

Notice now the real value of the READ and DATA statements: To expand the program to include more questions, instead of having to type five lines for each question and answer, one simply adds more data between what's there and the two QUITs. When line 500 becomes full, do this:

1. Remove the two QUITs, and the comma before them, at the end of line 500.

2. Add more DATA lines—510, 520, and so on.

3. Put DATA as the first word on each line.

4. Add the data, starting with the capital, then the state, and alternating between the two. Separate them with commas as in line 500.

5. Put two QUITs as the last two items of data.

Next month we'll see how and when to read data repeatedly, using the RESTORE statement.

Modified Drill Program

```
SC 100 PRINT"{CLR}"
PK 110 POKE53280,11:POKE53281,
       11:PRINT"{WHT}"
GJ 120 PRINT:PRINT
RH 130 Q$="WHAT IS THE CAPITAL
       OF "
BC 140 READA$,S$:IFA$="QUIT"TH
       EN5000
SX 150 FORI=1TO3:PRINTQ$;S$;"?
       "
AM 160 GOSUB1000
BX 170 IFC$<>A$THENGOSUB3000:N
       EXT:GOSUB4000:GOTO190
BQ 180 GOSUB2000
JX 190 GOTO140
XM 500 DATARALEIGH,NORTH CAROL
       INA,RICHMOND,VIRGINIA,Q
       UIT,QUIT
AS 1000 C$="":INPUTC$:IFC$=""T
        HEN5000
DS 1010 RETURN
KA 2000 C=C+1:PRINT"{DOWN}VERY
         GOOD!":FORT=1TO1000:N
        EXT:PRINT"{CLR}
        {3 DOWN}":RETURN
BS 3000 PRINT"{DOWN}SORRY, THA
        T'S NOT CORRECT.":FORT
        =1TO1000:NEXT:PRINT"
        {CLR}{3 DOWN}":RETURN
XP 4000 PRINT"THE ANSWER IS "A
        $"."
XA 4010 PRINT:PRINT"PRESS THE
        {SPACE}SPACE BAR TO GO
         ON."
JE 4020 GETS$:IFS$<>" "THEN402
        0
SM 4030 PRINT"{CLR}{3 DOWN}":R
        ETURN
BQ 5000 PRINTC"CORRECT.":END
```

Richard Mansfield
Editorial Director

When you start learning machine language (ML), the first thing you need is an assembler program. An assembler is to ML what the BASIC language is to programming in BASIC: It translates your commands into actions the computer can understand and perform when a program is run. Many assemblers are available commercially; some are included in books on ML; and some have been published in GAZETTE and COMPUTE!.

There are a variety of features to look for when deciding which assembler to use, but one of the most important is its complement of *pseudo-ops*, add-ons to the assembler which make life easier for the programmer. Pseudo-ops are the equivalent of options sold with automobiles, and, as you might expect, some such options are more accurately described as necessities than luxuries.

Unofficial Commands

An "op," short for opcode (which itself is short for operation code), is a number that describes an action for the microprocessor to carry out. For example, 96 tells the chip to return from a subroutine. An assembler's primary job is to translate the set of abbreviations programmers use into these opcodes. So, when you program in ML and use the command RTS (for ReTurn from Subroutine), the assembler reads this and stores it in the computer as 96.

In other words, the assembler takes your list of commands and translates them into a list of numbers. These numbers are the executable ML program. After the assembler has stored the numbers, you can SYS to them, and your ML program will run.

A pseudo-op, by contrast, is not part of the official list of ML abbreviations. Instead, it comes as an addition to an assembler and does something to make your programming easier or faster in the same way that LIST comes with BASIC. One of the most valuable pseudo-ops is the BYTE command (sometimes called ASC; the names of pseudo-ops vary from assembler to assembler). BYTE allows you to enter a table of numbers directly into RAM. These numbers are data, not program opcodes. They might be the parameters you want POKEd into the SID chip registers or a list of calories for various foods, whatever. When programming, you simply type BYTE, and the assembler knows that this isn't one of the normal opcode abbreviations—so it handles the information in a special way:

```
BYTE 112,27,88
```

These numbers will be stored in RAM exactly as you typed them. If this were a list of calories, you could create a parallel list of foods by using the BYTE pseudo-op:

```
BYTE "TWINKIE,GUMDROP,DONUT
```

where the BYTE pseudo-op tells the assembler to translate these characters into their proper screen codes. (Add a search routine and a few hundred more foods and you've got an ML calorie counter program.) BYTE, then, is a simple way to create tables, lists, and arrays of data in ML. You don't want to know how cumbersome this can be without that pseudo-op.

Another useful collection of related pseudo-ops gives you control over the destination of your program. D or DISK (or a variation thereof) entered into your program sends the resulting executable ML program to the disk drive instead of directly into RAM. This is valuable when you want your ML to reside in memory where the assembler or other programming utilities are located. It helps you avoid overwriting the resident programs. P or PRINTER sends the results to the printer for a hardcopy listing, and S or SCREEN lists there.

The = pseudo-op is essential. It allows you to assign values to *labels* and then use the labels throughout your program. It's quite similar to using variables in BASIC:

```
SCREEN = 1024
```

can then be used in such situations as:

```
STA SCREEN (to put whatever is in the Accumulator into screen memory)
STA SCREEN+512 (using +, the macro for automatic addition)
```

Among the benefits of such labels is that you can more easily read your program listing or utilize global access via search or replace.

Macros

One facility provided by some assemblers is *macros*, subroutines you can import into your program from disk. For example, if you frequently need to check for keyboard input, you could write a general purpose routine which PEEKs the keyboard for activity and save it as a macro. Then, when writing an ML program which needs to accomplish this, you could have the assembler insert this macro instead of typing each instruction by hand.

Macros have two weaknesses, though. First, it's often simply easier to use a subroutine instead, rather than inserting a routine repetitively throughout your program. Second, you have to spend some time passing parameters to macros, which means you have to remember *what* parameters, in which order, and then write them in. It's often better just to write the routine directly.

Tricks Worth Remembering

Todd Heimarck
Assistant Editor

Every once in a while, you run across a trick that's not an enormously useful programming tool but is still worth remembering. Here are a few such tricks, which are valuable primarily because they save you some time.

Loading And Saving

Running a BASIC program is a two-step process: First you load it into memory, then you type RUN. But on the 64, you can load and run a disk-based program by typing LOAD "*filename*",8: (don't press RETURN), and then holding down the SHIFT key and pressing RUN/STOP. Make sure you place a colon after the 8. On the 128, you can use RUN "*filename*" for BASIC, or BOOT "*filename*" for machine language programs.

When a directory is showing on the screen and you see the file you want to load, you can save a little typing by moving the cursor up to the line that lists the file. Type LOAD on top of the number of blocks, move the cursor just past the closing quotation mark, add *,8:* (again, the colon is important), and press RETURN. On the 128, you can replace the LOAD with D SHIFT-L (the abbreviation for DLOAD) or RUN. Press TAB a couple of times to get past the last quotation mark, then ESC-Q or ESC-@, and then RETURN.

If you put a line like 10 REM SAVE"*00filename*",8 at the beginning of a program, you can list line 10, cursor to the version number (to change it to 01, 02, 03, and so on) and press RETURN. To save the program, put the cursor on the line number and press the space bar to erase the 10 and the REM. Then just tap RETURN. When developing large, important programs, I usually alternate disks, putting the odd-numbered versions on one disk and the even-numbered versions on the other. When the disk begins to fill up, erase the old versions with the question mark wildcard: OPEN 15,8,15, "S0:??*filename*": CLOSE 15.

Shortcuts

At times, you'll discover that you've put too many commands on one line, and, when you want to add a few things to the middle of the line, the insert key won't allow you to go beyond the 64's 80-character limit. Rather than retyping the second part of the line, you can split it up by listing it twice. Change the line number of the second line—from 580 to 582, for example. Now you have two lines that are exactly the same. On the first one (line 580), use the space bar to erase the second part of the line. On the second line (582), move to the middle of the line and delete backwards.

A quick way to escape quote mode or insert mode is to press SHIFT-RETURN. This also useful if you change your mind after changing a line. The normal RETURN key causes a direct-mode command to execute or, if the line starts with a number, it adds the line to the program in memory. SHIFT-RETURN doesn't do either; it just puts the cursor on the beginning of the next line and turns off reverse mode, quote mode, and insert mode.

If you use a utility like "MetaBASIC" that lets you define the function keys, or if you have a 128, it's handy to define the function keys to list portions of your program. Change the definition for the f1 key to LIST-199, the definition for f3 to LIST200-399, and so on. (Since MetaBASIC limits key definition strings to ten characters, you may have to abbreviate LIST to L SHIFT-I.) You can then press the appropriate function key to see a specific part of the program.

To send output to a printer, you first open a channel with a line such as OPEN 1,4 or OPEN 1,4,7. Don't use CMD to divert PRINT statements to the open channel; CMD can be canceled (if the program does a GET, for example). Instead, use PRINT#. When you're developing a program that writes to the printer, you can save paper during testing by changing the OPEN to route output to device 3—OPEN 1,3, for example. Device 3 is the screen, so any further PRINT#1 statements would send lines to the screen instead of the printer. When the program is fully debugged and running, you can change the device number in the OPEN statement back to a 4.

Debugging

In programs that contain many DATA statements, it's common to make a typing error here and there. It's not much fun to proofread a list of numbers, so here are some suggestions for pinpointing typing mistakes. First, if you get an ILLEGAL QUANTITY error in the line that contains a READ followed by a POKE, the problem is most likely a number in DATA that's larger than 255 or smaller than 0. When this happens, PRINT PEEK(63) + PEEK(64)*256 will usually tell you which line of DATA contains the item that's out of range for POKEing. The equivalent memory locations on the 128 are 65 and 66.

Another problem is accidentally separating two numbers with a period instead of a comma. To find an errant period, use this two-line program (substitute memory locations 65 and 66 in line 2 on the 128):

```
1 READ A: IF A=INT(A) THEN 1
2 PRINT "CHECK LINE"; PEEK(63) +
  PEEK(64)*256: END
```

If there aren't any periods, line 1 will eventually run out of DATA to read. If you did accidentally type a period, line 2 will tell you which line to check.

RAM Usage On The Commodore 128

Ottis R. Cowper

Understanding and manipulating RAM on the Commodore 128 can be tricky business. This excerpt from Mapping the Commodore 128 *(from COMPUTE! Books) offers a technical overview of key RAM locations, and provides a wealth of useful information. Included are various tips and techniques for 128 programmers.*

The Commodore 128, as its name implies, has 128K of primary RAM in two 64K blocks. The computer's elaborate memory management system can mix RAM from one or both blocks together with ROM or I/O chip registers to create the configurations known as *banks*. In general the 128 sees RAM from block 0 in even-numbered banks (0, 4, 8, 14) and RAM from block 1 in odd-numbered banks (1, 5, 9). A notable exception is bank 15, where RAM from block 0 is seen. Another significant exception is that in every bank the system normally sees RAM from block 0 in locations 2–1023/$0002–$03FF. (Locations 0–1/$00–$01 are used for the processor's on-chip I/O port and are never seen as RAM.) This means that the lowest 1K of RAM in block 1 normally remains invisible and unused. The common 1K block and locations 1024–7167/$0400–$1BFF in block 0 have special uses. MMU registers, rather than RAM or ROM, are seen at addresses 65280–65284/$FF00–$FF04 in every bank configuration.

Two pointers in page 10/$0A indicate the range of locations in block 0 considered free RAM. Locations 2565–2566/$0A05–$0A06 point to the lowest free address, and locations 2567–2568/$0A06–$0A07 point to one byte beyond the highest free address. These pointers are initialized during the reset sequence to 7168/$1C00 and 65280/$FF00, respectively. The pointer values can also be changed with the Kernal MEMTOP and MEMBOT routines. However—unlike earlier Commodore computers—the values in these pointers have no effect on the range of addresses used by BASIC.

BASIC RAM Usage

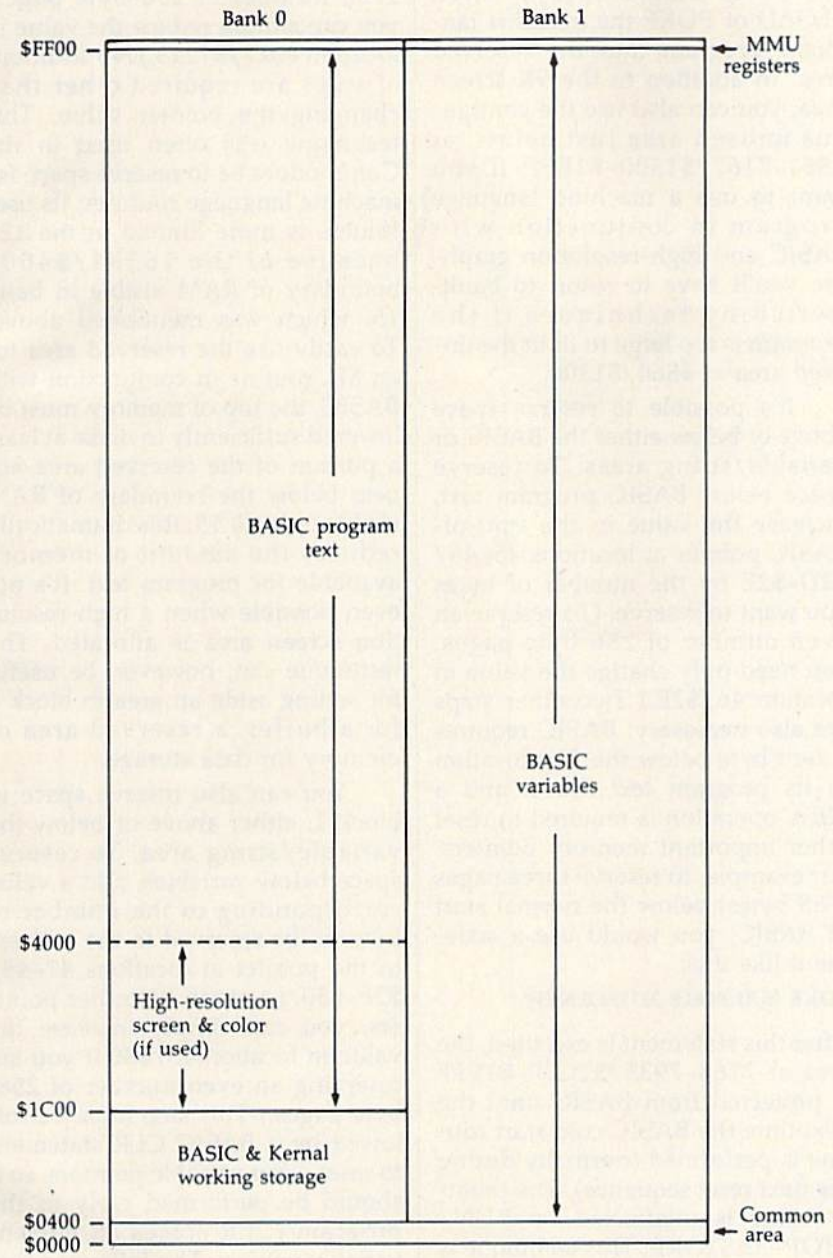
For BASIC programming, the areas of RAM normally available for storage of programs and variables are locations 7168–65279/$1C00–$FEFF in block 0 and 1024–65279/$0400–$FEFF in block 1. This is a total of 122,368 bytes of available RAM space (illustrated in Figure 1). This explains why part of the message you see when you turn on or reset the computer says 122365 BYTES FREE. (The three missing bytes are to account for the zero byte required by BASIC before the first program line and the two zero bytes used to mark the end of the program.)

Actually, it's a bit misleading to claim that many free bytes, since you can't write a BASIC program 120,000 bytes long. The free RAM is divided into two distinct segments: 58,112 bytes in block 0 for BASIC program text and 64,256 bytes in block 1 for variables and strings. (For comparison, the Commodore 64 offers 38,911 bytes for program text and variables combined.)

As noted in Figure 1, there is one additional factor which affects the amount of memory available for program text. When you use a GRAPHIC statement to set up a high-resolution screen, an additional 9K is reserved in block 0: 1K at 7168–8191/$1C00–$1FFF for color information and 8K at 8192–16383/$2000–$3FFF for the screen bitmap. In this case, the amount of RAM available for BASIC program text is reduced to 48,896 bytes (locations 16384–65279/$4000–$FEFF in block 0). If a program is already in memory when the GRAPHIC statement is executed, program text will be moved upward in memory—the starting address will be changed from 7169/$1C01 to 16385/$4001—and the program will be relinked to work at the new addresses. Once a high-resolution memory area is established, it remains allocated until a GRAPHIC CLR statement is executed, at which time the program text is moved down to start at 7169/$1C01 again.

Pointers in zero page and page 18/$12 indicate the amount of RAM currently used for program text and variables. BASIC program text is assumed to begin at the address in block 0 specified in loca-

Figure 1. BASIC RAM Usage



tions 45–46/$2D–$2E. That pointer is always initialized to 7169/$1C01 during the BASIC cold start routine. Unlike the Commodore 64, which sets its start-of-BASIC pointer according to the value in the system's start-of-free-memory pointer, the 128 sets the address value without regard for the value in locations 2565–2566/$0A05–$0A06. Locations 4626–4627/$1212–$1213 point to one byte beyond the highest address in block 0 available for program text. That pointer is initialized during BASIC cold start to 65280/$FF00, again without regard to the value in the Kernal memory pointer at locations 2567–2568/$0A07–$0A08.

The actual ending address of the program text currently in memory is specified by the value in locations 4624–4625/$1210–$1211. That pointer is initialized during the BASIC CLR routine with an address value that is two bytes beyond the starting address in locations 45–46/$2D–$2E. The pointer value is updated each time a BASIC program line is added or deleted. An OUT OF MEMORY error occurs if the address in locations 4624–4625/$1210–$1211 reaches the value in locations 4626–4627/$1212–$1213. The ending address pointer is set after a LOAD to the address of the last byte loaded, and the SAVE routine uses the values in the starting and ending address pointers as the starting and ending addresses for the block of memory to be saved.

The address in the pointer at locations 47–48/$2F–$30 marks the start of scalar (nonarray) variables in bank 1. The pointer is initialized to 1024/$0400 during the BASIC cold start routine. A pointer at locations 49–50/$31–$32 marks the end of scalar variables and the beginning of arrays; another pointer at locations 51–52/$33–$34 marks the end of arrays and the beginning of free memory in block 1. The latter two pointers are reset to the value in locations 47–48/$2F–$30 during the BASIC CLR routine.

The free memory in block 1 is used to hold strings of all types—constants, variables, and arrays. A pointer at locations 57–58/$39–$3A holds an address which is one byte beyond the highest address of strings in block 1. It is initialized during BASIC cold start to point to 65280/$FF00. The string pool is filled from this address downward toward the bottom of free memory indicated in locations 51–52/$33–$34. A pointer at locations 53–54/$35–$36 marks the current address of the bottom of the string pool. That pointer is reset to the value in locations 57–58/$39–$3A during the BASIC CLR routine. An OUT OF MEMORY error occurs if the value in locations 53–54/$35–$36 reaches the value in locations 51–52/$33–$34.

Reserving RAM

There are occasions when you will want to divert an area of RAM from its normal usage. For example, you may need to set aside space for a machine language routine, an alternate screen display, or a data buffer. For machine language (ML) programming, you can use any area of RAM if you are willing to learn the intricacies of the 128's banking scheme. Otherwise, it's best to restrict your programming to certain known areas. For a machine language routine to be used in conjunction with a BASIC program,

you'll need to select an area which BASIC doesn't normally use, or to take away some memory that otherwise would be used for program text or variable storage.

Locations 4864–7167/$1300–$1BFF in block 0 are currently unused (even though they are called "reserved" in some Commodore literature). This 2304-byte area is the largest segment of unused, protected RAM in the 128, and it is becoming extremely popular with 128 ML programmers—much like the $C000 block in the Commodore 64. You can expect to see many ML programs using this area.

Other, shorter blocks are also available if certain BASIC features are not used. If tape is not used, the 256 bytes at 2816–3071/$0B00–$0BFF are available. However, unlike other free blocks, this page may be overwritten during a reset because disk boot sectors are read into this area. Thus, the time-honored Commodore tradition of using the cassette buffer for short ML routines is less suitable in the 128. (It's annoying to have to reload your routine after each reset.)

If your program doesn't use RS-232 communications, the two RS-232 buffers at 3072–3583/$0C00–$0DFF provide a 512-byte workspace. This is probably the best area for short ML routines that you wish to use in conjunction with BASIC. (Unlike the cassette buffer, this area always survives reset intact.) If your program doesn't use sprites, the 512-byte sprite definition area at 3584–4095/$0E00–$0FFF is also available. Of course, if your program uses neither tape nor RS-232 nor sprites, you can use the full 1280 bytes at 2816–4095/$0B00–$0FFF, or any subsection thereof.

To use a large ML program in conjunction with BASIC, there is an easy way to reserve over 11K of protected RAM. However, this technique works only if neither the BASIC nor ML program requires high-resolution graphics. The trick is to use the BASIC GRAPHIC statement to set aside a high-resolution screen area at 7168–16383/$1C00–$3FFF. As mentioned above, this area remains allocated until a GRAPHIC CLR statement is executed. Simply begin your BASIC program with a line like GRAPHIC 1:GRAPHIC 0 (or GRAPHIC 1:GRAPHIC 5 if you want to use the 80-column display). Then BLOAD or POKE the machine language program into the reserved area. In addition to the 9K screen area, you can also use the contiguous unused area just below, at 4864–7167/$1300–$1BFF. If you want to use a machine language program in conjunction with BASIC and high-resolution graphics, you'll have to resort to bank-switching techniques if the program is too large to fit in the unused area at 4864/$1300.

It's possible to reserve space above or below either the BASIC or variable/string areas. To reserve space below BASIC program text, increase the value in the start-of-BASIC pointer at locations 45–46/$2D–$2E by the number of bytes you want to reserve. (To reserve an even number of 256-byte pages, you need only change the value in location 46/$2E.) Two other steps are also necessary: BASIC requires a zero byte below the first location in its program text space, and a NEW operation is required to reset other important memory pointers. For example, to reserve three pages (768 bytes) below the normal start of BASIC, you would use a statement like this:

```
POKE 46,31:POKE 31*256,0:NEW
```

After this statement is executed, the area at 7168–7935/$1C00–$1EFF is protected from BASIC until the next time the BASIC cold start routine is performed (normally during the next reset sequence). The pointer value is unaffected by RUN/STOP–RESTORE. This technique is less useful when a high-resolution screen area is allocated. In that case, the start of BASIC is moved to 16384/$4000. The technique for reserving space at the start of BASIC still works, but the reserved memory will lie above 16383/$3FFF, which is the highest address seen as RAM in bank 15—the bank in which Kernal ROM is visible and to which BASIC defaults. Thus, an ML routine above that boundary will be invisible unless you tinker with the MMU configuration register.

Space can be reserved at the top of the BASIC program area by reducing the value in the pointer at locations 4626–4627/$1212–$1213 by the desired number of bytes. (Again, if you wish to reserve an even number of 256-byte pages, you can simply reduce the value in location 4627/$1213.) No additional steps are required other than changing the pointer value. This technique was often used in the Commodore 64 to reserve space for machine language routines; its usefulness is more limited in the 128 because of the 16384/$4000 boundary of RAM visible in bank 15, which was mentioned above. To easily use the reserved area for an ML routine in conjunction with BASIC, the top of memory must be lowered sufficiently to make at least a portion of the reserved area appear below the boundary of RAM visible in bank 15; this dramatically reduces the amount of memory available for program text. It's not even possible when a high-resolution screen area is allocated. The technique can, however, be useful for setting aside an area in block 0 for a buffer, a reserved area of memory for data storage.

You can also reserve space in block 1, either above or below the variable/string area. To reserve space below variables, add a value corresponding to the number of bytes to be reserved to the address in the pointer at locations 47–48/$2F–$30. (As with the other pointers, you can simply increase the value in location 48/$30 if you are reserving an even number of 256-byte pages.) This step must be followed by a BASIC CLR statement to reset other variable pointers, so it should be performed early in the program (CLR erases all current variable values). The following line reserves an additional 1K at the bottom of variable space, locations 1024–2047/$0400–$07FF in block 1:

```
100 POKE 48,8:CLR
```

Once established, the reserved area will remain intact until the next time the BASIC cold start routine is executed, normally at the next reset. The setting is unaffected by RUN/STOP–RESTORE.

Since this reserved RAM is in block 1, it can't be used for ML routines as easily as the RAM from block 0. There is no standard bank configuration that makes BASIC and Kernal ROM visible in conjunction with block 1 RAM. Of course, it

is possible to access Kernal or BASIC routines indirectly by using the JSRFAR or JMPFAR routines. One use for a reserved area in block 1 would be for an alternate 40-column screen.

To reserve space above strings, subtract a value corresponding to the number of bytes to be reserved from the address in the pointer at locations 57–58/$39–$3A. (As with the other pointers, you can simply increase the value in location 58/$3A if you are reserving an even number of 256-byte pages.) This step must also be followed by a BASIC CLR statement to reset other string pointers, so it should be performed early in the program (CLR erases all variable values). The following line reserves 31K at the top of string space, locations 32768–65279/$8000–$FEFF in block 1:

```
100 POKE 58,128:CLR
```

Once established, the reserved area will remain intact until the next time the BASIC cold start routine is executed—normally at the next reset. The setting is unaffected by RUN/STOP–RESTORE. As mentioned above, this area can't be easily used for machine language routines since it is in block 1. One appropriate use for a reserved area here would be for a data buffer—to hold downloaded text in a telecommunications program, for example.

Using ML Without BASIC

You have several options when using ML programs alone, without BASIC. The simplest, if your program is less than 9K (9216 bytes) long, is to leave the system in its default bank 15 configuration and use the visible area of block 0 RAM at 7168–16383/$1C00–$3FFF. (If you need a few more bytes, you can stretch the start of the program down to the bottom of the reserved area at 4864/$1300.) With this setup, you have full access to the I/O chip registers and all the routines in BASIC and Kernal ROM.

If you need more space, but still want access to Kernal routines, you can change the settings of bits 1–3 of the MMU configuration register to switch out BASIC ROM. Storing a value of 14/$0E in the register at 65280/$FF00 will set up a configuration with block 0 RAM, I/O chip registers, and Kernal ROM. In this case, you'll have access to over 43K of contiguous free RAM, locations 4864–49151/$1300–$BFFF. If you want to use a high-resolution screen in conjunction with your ML routine, it's easiest to set up the screen in its normal location (7168–16383/$1C00–$3FFF). This means that if your program is too long to fit below the screen areas you'll need to switch out BASIC to have some RAM visible with Kernal ROM. (You could still use the Kernal JSRFAR routine to access BASIC routines—if you wanted to use some of the graphics drawing routines, for example.)

Although it is possible to set up a custom MMU configuration that makes block 1 RAM visible with either BASIC or Kernal ROM (or both), there's rarely a need for such gyrations. It's usually easiest to locate your executable machine language in block 0 and use block 1 for data storage.

Several obscure techniques are available to squeeze a few more bytes out of the 128. For example, you can gain access to the lowest 1K of block 1 RAM, which is normally covered by the common area from block 0, by changing the value in the MMU RAM configuration register (54534/$D506).

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The highest page of memory, locations 65280–65535/$FF00–$FFFF, in each RAM block is normally unused by BASIC and contains a few bytes of free RAM as well as some important routines and vectors. The MMU configuration and load configuration registers always appear in the lowest five bytes of this area, locations 65280–65284/$FF00–$FF04. They should never be disturbed unless you know the effect of the values you are storing there.

You should also exercise care when changing the contents of locations 65285–65348/$FF05–$FF44 in either RAM block. These areas contain copies of the interrupt and reset handling routines. (These areas are initialized by the Kernal RESET routine.) If an interrupt or re-

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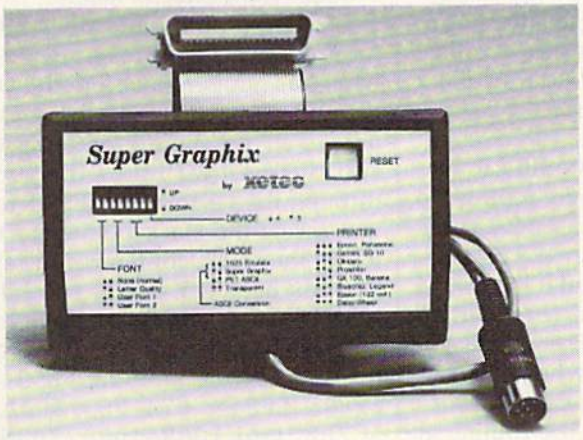

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set occurs while the system is configured for a bank where Kernal ROM is not visible—bank 0 or 1, for example—a crash will occur if the area in the visible RAM block does not contain a routine to redirect the reset or interrupt to a proper handling routine.

The highest six addresses in each RAM block, locations 65530–65535/$FFFA–$FFFF, contain copies of the processor reset and interrupt vectors. This area is initialized during the reset sequence, and, like the handling routines to which these vectors point, these vector addresses should be changed with care. The system will crash if a RAM vector does not contain the address of a valid handling routine when an interrupt or reset occurs while that block is visible.

Free space in this page includes the 181 bytes at locations 65349–65529/$FF45–$FFF9 in block 0 and the 176 bytes at 65349–65524/$FF45–$FFF4 in block 1. However, locations 65488–65519/$FFD0–$FFEF in block 0 will be overwritten whenever the computer is reset. The Z80 microprocessor used by the 128's CP/M mode has control briefly after a reset or when the computer is first powered on. The initialization steps performed by the Z80 include copying two routines into block 0 RAM. One, at 65488–65503/$FFD0–$FFDF, is an 8502 machine language routine to surrender control to the Z80; the other, at 65504–65519/$FFE0–$FFEF, is a Z80 machine language routine to surrender control to the 8502. These routines have no use in 128 mode—they can be used only in CP/M mode—but they are recopied to block 0 during each reset. (Actually, there is one situation where disturbing these routines can cause a problem. If you overwrite the routine at 65488/$FFD0 and then attempt to start CP/M with a BASIC BOOT command, the system will crash. The machine language in the CP/M disk's boot sector expects that routine to be intact.)

The free areas in this page are of somewhat limited usefulness for machine language subroutines because it is not possible to load data into this area. The Kernal LOAD routine exits whenever the load address reaches or exceeds 65280/$FF00, so you will have to load any code for this area into another area and then transfer it into the proper addresses. (On the other hand, there's nothing in the SAVE routine to prevent saving the contents of this page.)

Locations 65525–65529/$FFF5–$FFF9 in block 1 have a special use. The first three bytes, locations 65525–65527/$FFF5–$FFF7, are an initialization signature; after the Kernal RESET routine has been performed at least once, these locations will contain the character codes for the letters *CBM*. As long as the signature locations contain these codes, the initialization test subroutine will take an indirect jump to the address specified in locations 65528–65529/$FFF8–$FFF9, called the system vector or soft reset vector. This vector normally points to 57892/$E224 in Kernal ROM, a routine that does nothing more than reinitialize the signature and vector. You can change the vector to point to a routine of your own to add additional steps to the reset sequence or to initiate an entirely new reset sequence. One restriction applies: The routine you specify in the vector must be visible in the bank 15 configuration, since that is how the system is set up when the jump through the vector is taken.

When tapping into the RESET routine, you need to be aware of what has happened before the vector jump is taken and what hasn't happened yet. Before entering the subroutine that takes the jump through the vector, the RESET routine resets the stack pointer to the top of the stack, configures the system for bank 15, resets the other MMU registers to their default values, and recopies the common routines to locations 65285–65348/$FF05–$FF44, 674–763/$02A2–$02FB, and 1008–1020/$03F0–$03FC. However, the initialization routines IOINIT, RAMTAS, RESTOR, and CINT are normally called *after* the return from the jump through this vector. If your routine ends with RTS to return to the normal reset sequence, you can't use the vector diversion to change default indirect vector settings or to alter screen parameters. If you use the vector to substitute your own reset sequence, you'll need to call one or more of these subroutines to complete system initialization. At least the IOINIT routine or some equivalent initialization routine is necessary, since the reset signal generated by pressing the reset button also resets the VIC and VDC (80-column) video chips, clearing all chip registers to zero. IOINIT initializes the video chip registers to their standard settings.

One interesting use of this vector is to make a machine language program unstoppable by anything short of turning off the computer. To accomplish this, change the vector to point to the initialization routine of the program to be made unstoppable. That initialization step should include calls to at least the IOINIT and CINT routines, and it should also disable RUN/STOP–RESTORE by redirecting the NMI vector. Here is a short example, which can be entered using the 128's built-in machine language monitor:

```
0C00  LDA  #$F8     ;Use Kernal INDSTA
0C02  STA  $C3      ; routine to change
0C04  LDA  #$FF     ; system reset vector in
0C06  STA  $C4      ; bank 1 to point to the
0C08  LDA  #$C3     ; routine at $0C28
0C0A  STA  $02B9
0C0D  LDA  #$28
0C0F  LDX  #$01
0C11  LDY  #$00
0C13  JSR  $FF77
0C16  LDA  #$0C
0C18  LDX  #$01
0C1A  INY
0C1B  JSR  $FF77
0C1E  LDA  #$33     ;Change the INMI in-
0C20  STA  $0318    ; direct vector to point
0C23  LDA  #$FF     ; to the interrupt return
0C25  STA  $0319    ; routine (disables
                    ; RUN/STOP-
                    ; RESTORE)
0C28  JSR  $FF84    ;Kernal IOINIT routine
0C2B  JSR  $C000    ;Kernal CINT routine
0C2E  LDX  #$00     ;Loop to repeatedly
0C30  LDA  $0C40,X  ; print the text at $0C40
0C33  BEQ  $0C2E
0C35  JSR  $FFD2
0C38  INX
0C39  BNE  $0C30
;Text for message
>0C40 49 20 43 41 4E 27 54 20
>0C48 42 45 20 53 54 4F 50 50
>0C50 45 44 21 0D 0D 00
```

Use J F0C00 (from the monitor) or BANK 15:SYS 3072 (from BASIC) to start the routine. Once started, it cannot be stopped with either reset or RUN/STOP–RESTORE.

Obviously, you should make sure that your ML program is fully debugged—and be sure that you have a backup copy, just in case it isn't—before you use this technique to make the program unstoppable. Once the program starts, the only way to stop it is to turn off the computer.

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Sprite Magic

See instructions in article on page 44 before typing in.

```
C000:4C 20 C3 00 01 03 04 20 64
C008:B8 C0 A9 04 85 FC A9 00 FE
C010:85 FB 85 A7 A9 D8 85 A8 E2
C018:A9 15 8D 28 02 A9 03 8D 32
C020:29 02 A0 00 B1 FD AA AD 53
C028:30 02 F0 03 4C 8A C0 A9 48
C030:CF 91 FB 8A 0A AA B0 08 8A
C038:AD 03 C0 91 A7 4C 45 C0 3C
C040:AD 04 C0 91 A7 C8 C0 08 B4
C048:D0 DD 18 A5 FB 69 08 85 22
C050:FB 85 A7 A5 FC 69 00 85 93
C058:FC 69 D4 85 A8 E6 FD D0 53
C060:02 E6 FE CE 29 02 AD 29 3F
C068:02 D0 B7 18 A5 FB 69 10 97
C070:85 FB 85 A7 A5 FC 69 00 D2
C078:85 FC 69 D4 85 A8 CE 28 0B
C080:02 AD 28 02 F0 03 4C 1D DC
C088:C0 60 86 61 A9 00 8D 2A FB
C090:02 06 61 2E 2A 02 06 61 6A
C098:2E 2A 02 AE 2A 02 A9 CF 63
C0A0:91 FB C8 A9 F7 91 FB 88 24
C0A8:BD 03 C0 91 A7 C8 91 A7 26
C0B0:C8 C0 08 D0 D7 4C 4A C0 1A
C0B8:A9 00 85 FE AD 2B 02 85 53
C0C0:FD 06 FD 26 FE 06 FD 26 17
C0C8:FE 06 FD 26 FE 06 FD 26 9F
C0D0:FE 06 FD 26 FE 06 FD 26 A7
C0D8:FE 60 20 B8 C0 A0 00 B1 BB
C0E0:FD 49 FF 91 FD C8 C0 40 A1
C0E8:D0 F5 60 20 B8 C0 A0 3E A6
C0F0:88 88 B1 FD 0A 08 C8 C8 B9
C0F8:A2 03 B1 FD 28 2A 08 91 2E
C100:FD 88 CA D0 F5 28 C0 FF DC
C108:D0 E6 60 20 B8 C0 A0 00 C5
C110:C8 C8 B1 FD 4A 08 88 88 4C
C118:A2 03 B1 FD 28 6A 08 91 50
C120:FD C8 CA D0 F5 28 C0 3F 4C
C128:D0 E6 60 20 B8 C0 A0 00 E5
C130:B1 FD 99 CB CA C8 C0 03 F9
C138:D0 F6 B1 FD 88 88 88 91 01
C140:FD C8 C8 C8 C8 C0 3F D0 33
C148:F1 A2 00 A0 3C BD CB CA B2
C150:91 FD C8 E8 E0 03 D0 F5 6E
C158:60 20 B8 C0 A0 3C A2 00 72
C160:B1 FD 9D CB CA C8 E8 E0 D8
C168:03 D0 F5 A0 3C B1 FD C8 D7
C170:C8 C8 91 FD 88 88 88 88 9C
C178:10 F3 A0 00 B9 CB CA 91 39
C180:FD C8 C0 03 D0 F6 60 20 C0
C188:B8 C0 A0 00 98 AA E8 E8 D6
C190:A9 03 85 61 A9 08 8D 37 30
C198:02 B1 FD 4A 91 FD 3E CB BA
C1A0:CA CE 37 02 AD 37 02 D0 63
C1A8:F0 C8 CA C6 61 A5 61 D0 D1
C1B0:E3 C0 3F 90 D7 A0 00 B9 42
C1B8:CB CA 91 FD C8 C0 3F D0 7F
C1C0:F6 60 A9 93 20 D2 FF AD 40
C1C8:00 DC 85 61 29 0F 49 0F 71
C1D0:AA AD 00 D0 18 7D 42 C2 20
C1D8:8D 00 D0 AD 10 D0 7D 4D 24
C1E0:C2 8D 10 D0 AD 01 D0 18 63
C1E8:7D 58 C2 8D 01 D0 20 12 10
C1F0:C3 AD 8D 02 29 01 18 6D 7E
C1F8:F8 07 8D F8 07 AD 8D 02 08
C200:29 02 4A 49 FF 38 6D F8 2D
C208:07 8D F8 07 A5 61 29 10 19
C210:D0 B5 AD 00 DC 29 10 F0 BD
C218:F9 AD 2B 02 8D F8 07 20 0A
C220:3B C4 A9 FF 8D 00 D0 A9 61
C228:00 8D 10 D0 A9 80 8D 01 8B
C230:D0 4C B1 C2 20 B8 C0 A0 99
C238:00 98 91 FD C8 C0 3F D0 8E
C240:F9 60 00 00 00 00 FF FF DA
C248:FF 00 01 01 01 00 00 00 06
C250:00 FF FF FF 00 00 00 00 D5
C258:00 FF 01 00 00 FF 01 00 FF
C260:00 FF 01 12 53 50 52 49 F0
C268:54 45 20 4D 41 47 49 43 3F
C270:92 5F 45 52 52 4F 52 20 79
C278:4F 4E 20 53 41 56 45 2F 8F
C280:4C 4F 41 44 5F 12 54 92 EA
C288:41 50 45 20 4F 52 20 12 83
C290:44 92 49 53 4B 3F 5F 46 97
C298:49 4C 45 4E 41 4D 45 3A 67
C2A0:5F 45 4E 54 45 52 20 43 2D
C2A8:4F 4C 4F 52 20 4B 45 59 0A
C2B0:5F A9 63 A0 C2 85 FB 84 6F
C2B8:FC A0 28 A9 20 99 BF 07 72
C2C0:88 D0 FA B1 FB C8 C9 5F 2F
C2C8:D0 F9 88 84 61 98 4A 49 D9
C2D0:FF 38 69 14 A8 A2 18 18 EA
C2D8:20 F0 FF A9 92 20 D2 FF FF
C2E0:A0 00 B1 FB 20 D2 FF C8 C1
C2E8:C4 61 90 F6 60 85 FB 84 40
C2F0:FC A0 28 A9 20 99 BF 07 AA
C2F8:88 D0 FA A2 18 A0 00 18 DB
C300:20 F0 FF A0 00 B1 FB C9 66
C308:5F F0 06 20 D2 FF C8 D0 37
C310:F4 60 AE 35 02 F0 08 A0 D7
C318:00 C8 D0 FD CA D0 FA 60 BB
C320:A9 93 20 D2 FF A9 00 8D C6
C328:86 02 8D 38 02 A9 08 20 8F
C330:D2 FF A9 80 8D 8A 02 A9 A2
C338:30 8D 35 02 A9 FF 8D 2B 95
C340:02 A9 00 8D 30 02 AD 06 F6
C348:C0 8D 26 D0 AD 04 C0 8D F1
C350:25 D0 8D 27 D0 20 07 C0 98
C358:A9 FF 8D 00 D0 A9 80 8D 22
C360:01 D0 AD 2B 02 8D F8 07 44
C368:A9 01 8D 15 D0 A9 00 8D C2
C370:1C D0 A9 0C 8D 21 D0 8D 50
C378:20 D0 8D 2C 02 8D 2D 02 5B
C380:20 B1 C2 20 3B C4 20 07 13
C388:C0 20 1E C4 AD 00 DC 48 F7
C390:29 0F 49 0F 8D 2E 02 68 1C
C398:29 10 8D 2F 02 20 E4 FF B7
C3A0:F0 06 20 EE C4 4C 86 C3 3D
C3A8:20 12 C3 AD 2F 02 D0 03 3E
C3B0:20 59 C4 20 1E C4 AD 2F C7
C3B8:02 49 10 8D 34 02 AD 2E A1
C3C0:02 F0 C3 AE 2E 02 BD 42 20
C3C8:C2 AC 30 02 F0 01 0A 18 BA
C3D0:6D 2C 02 8D 2C 02 18 AD 7A
C3D8:2D 02 7D 58 C2 8D 2D 02 55
C3E0:AE 2C 02 10 11 A2 00 8E AD
C3E8:2C 02 A2 17 AD 30 02 F0 EF
C3F0:02 A2 16 8E 2C 02 AE 2C C0
C3F8:02 E0 18 90 05 A2 00 8E 07
C400:2C 02 AC 2D 02 10 05 A0 83
C408:14 8C 2D 02 AC 2D 02 C0 63
C410:15 90 05 A0 00 8C 2D 02 81
C418:20 1E C4 4C 86 C3 AE 2D 64
C420:02 AC 2C 02 20 F0 FF A4 E4
C428:D3 AD 30 02 D0 05 A9 20 3B
C430:91 D1 60 A9 20 91 D1 C8 51
C438:91 D1 60 A2 00 A0 1E 18 0C
C440:20 F0 FF A9 12 20 D2 FF 67
C448:AE 2B 02 8E F8 07 A9 00 54
C450:20 CD BD A9 20 20 D2 FF D6
C458:60 20 B8 C0 AD 2D 02 0A 6D
C460:6D 2D 02 85 61 AD 2C 02 A0
C468:4A 4A 4A 18 65 61 A8 AD 24
C470:2C 02 29 07 49 07 AA E8 CA
C478:86 61 38 A9 00 2A CA D0 4E
C480:FC AE 30 02 D0 2F 85 61 0A
C488:AD 34 02 D0 10 A9 00 8D F7
C490:31 02 B1 FD 25 61 D0 05 9E
C498:A9 01 8D 31 02 A5 61 49 AE
C4A0:FF 31 FD AE 31 02 F0 02 96
C4A8:05 61 91 FD AD 38 02 F0 62
C4B0:03 20 1E CA 60 85 62 4A 5C
C4B8:05 62 85 62 AE 34 02 D0 4F
C4C0:0E A2 00 8E 31 02 31 FD D4
C4C8:D0 05 A9 01 8D 31 02 A5 1C
C4D0:62 49 FF 31 FD A6 61 CA 09
C4D8:85 61 AD 33 02 4A 2A CA BE
C4E0:D0 FC AE 31 02 D0 02 A9 FB
C4E8:00 05 61 91 FD 60 8D 32 B7
C4F0:02 AE 0A C5 DD 0A C5 F0 58
C4F8:04 CA D0 F8 60 CA 8A 0A 2E
C500:AA BD 33 C5 48 BD 32 C5 76
C508:48 60 27 85 89 86 8A 4D D5
C510:4A 93 12 91 11 9D 1D 87 C1
C518:8B 31 32 33 34 13 88 8C BA
C520:21 22 23 24 56 53 4C 18 1C
C528:58 59 42 20 A0 2B 2D 04 90
C530:5F 46 0A C1 EA C0 58 C1 27
C538:2A C1 86 C1 C1 C1 33 C2 74
C540:D9 C0 7F C5 89 C5 8F C5 7D
C548:9D C5 BF C5 F4 C5 06 C6 F9
C550:06 C6 06 C6 06 C6 17 C6 FD
C558:22 C6 3E C6 5E C6 5E C6 6C
C560:5E C6 5E C6 AE C6 1C C8 96
C568:C3 C8 DA C8 AD C5 B6 C5 A7
C570:85 C5 58 C4 58 C4 E8 C6 F5
C578:F6 C6 41 C9 51 CA 5A CA 2B
C580:CE 2D 02 4C A9 C5 EE 21 27
C588:D0 60 EE 2D 02 4C A9 C5 9F
C590:CE 2C 02 AD 30 02 F0 11 26
C598:CE 2C 02 4C A9 C5 EE 2C 0A
C5A0:02 AD 30 02 F0 03 EE 2C 5C
C5A8:02 68 68 4C E0 C3 AD 1D AF
C5B0:D0 49 01 8D 1D D0 60 AD 8A
C5B8:17 D0 49 01 8D 17 D0 60 08
C5C0:A9 10 8D 30 02 A9 01 8D 20
C5C8:1C D0 20 07 C0 A2 01 8E 2C
C5D0:33 02 BD 03 C0 8D 20 D0 AB
C5D8:AD 04 C0 8D 25 D0 AD 05 F9
C5E0:C0 8D 27 D0 AD 06 C0 8D B6
C5E8:26 D0 AD 2C 02 29 FE 8D 74
C5F0:2C 02 4C A9 C5 A9 00 8D 99
C5F8:30 02 8D 20 D0 8D 1C D0 96
C600:AD 04 C0 8D 27 D0 60 38 CB
C608:AD 32 02 E9 31 8D 33 02 FF
C610:AA BD 03 C0 8D 20 D0 60 BD
C618:A9 00 8D 2C 02 8D 2D 02 91
C620:4C A9 C5 20 DA C0 20 07 1A
C628:C0 20 DA C0 20 07 C0 20 44
C630:B8 C0 A0 00 B1 FD 99 8B A2
C638:CA C8 C0 40 D0 F6 60 20 BC
C640:B8 C0 A0 00 B9 8B CA 91 91
C648:FD C8 C0 40 D0 F6 60 90 D6
C650:05 1C 9F 9C 1E 1F 9E 81 51
C658:95 96 97 98 99 9A 9B A9 EA
C660:A1 A0 C2 20 B5 C2 20 85 BF
C668:CA A2 00 DD 4F C6 F0 08 61
C670:E8 E0 10 D0 F6 4C B1 C2 C8
C678:38 AD 32 02 E9 21 A8 8A A3
C680:99 03 C0 AD 30 02 D0 09 C2
C688:AD 04 C0 8D 27 D0 4C A3 97
C690:C6 AD 04 C0 8D 25 D0 AD C9
C698:05 C0 8D 27 D0 AD 06 C0 07
C6A0:8D 26 D0 AE 33 02 BD 03 A3
C6A8:C0 8D 20 D0 4C B1 C2 A9 63
C6B0:D2 A0 C6 20 B5 C2 20 E4 88
C6B8:FF 38 E9 30 30 F8 C9 0A 97
C6C0:B0 F4 85 61 38 A9 09 E5 0B
C6C8:61 0A 0A 0A 8D 35 02 4C FC
C6D0:B1 C2 43 55 52 53 4F 52 76
C6D8:20 56 45 4C 4F 43 49 54 E7
C6E0:59 20 28 30 2D 39 29 3F 0B
C6E8:5F AD 2B 02 C9 FF F0 06 4D
C6F0:EE 2B 02 20 3B C4 60 CE 7F
C6F8:2B 02 20 B8 C0 A5 2E C5 EA
C700:FE 90 04 EE 2B 02 60 20 E4
C708:3B C4 60 A0 00 8C 37 02 1F
C710:A9 A4 20 D2 FF A9 9D 20 D0
C718:D2 FF 20 85 CA AC 37 02 E6
C720:85 61 A9 20 20 D2 FF A9 F7
C728:9D 20 D2 FF A5 61 C9 0D 3C
C730:F0 2B C9 14 D0 0D C0 00 B9
C738:F0 D3 88 A9 9D 20 D2 FF F3
C740:4C 0D C7 29 7F C9 20 90 B8
C748:C4 C0 14 F0 C0 A5 61 99 F4
C750:00 02 20 D2 FF A9 00 85 BD
C758:D4 C8 4C 0D C7 A9 5F 99 1C
C760:00 02 98 60 20 E7 FF A9 D3
C768:85 A0 C2 20 B5 C2 20 85 BB
C770:CA A2 01 C9 54 F0 0B A2 E9
C778:08 C9 44 F0 05 68 68 4C FC
```

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C780:B1 C2 8D 36 02 A0 00 A9 EA
C788:01 20 BA FF A9 97 A0 C2 A7
C790:20 ED C2 20 0B C7 D0 07 26
C798:AD 36 02 C9 54 D0 ED AD D8
C7A0:36 02 C9 44 D0 42 A9 40 6C
C7A8:8D 14 02 A9 30 8D 15 02 C2
C7B0:A9 3A 8D 16 02 A0 00 B9 03
C7B8:00 02 99 17 02 C8 CC 37 71
C7C0:02 D0 F4 A9 2C 99 17 02 B6
C7C8:A9 50 99 18 02 AD 32 02 23
C7D0:C9 53 D0 0C A9 2C 99 19 3F
C7D8:02 A9 57 99 1A 02 C8 C8 8B
C7E0:C8 C8 C8 C8 C8 4C F6 C7 D9
C7E8:A0 00 B9 00 02 99 14 02 A0
C7F0:C8 CC 37 02 D0 F4 98 A2 4D
C7F8:14 A0 02 20 BD FF A9 A0 DE
C800:85 B2 60 53 41 56 45 20 50
C808:41 4C 4C 20 46 52 4F 4D 40
C810:20 48 45 52 45 3F 20 28 21
C818:59 2F 4E 29 5F 20 64 C7 8A
C820:20 B8 C0 A9 03 A0 C8 20 EE
C828:B5 C2 20 85 CA C9 59 D0 A2
C830:07 A2 00 A0 40 4C 43 C8 7A
C838:18 A5 FD 69 40 AA A5 FE 8C
C840:69 00 A8 A5 FD 85 FB A5 99
C848:FE 85 FC 20 E1 C8 A9 FB DD
C850:20 D8 FF B0 0B 20 B7 FF 7B
C858:D0 06 20 EB C8 4C B1 C2 34
C860:20 EB C8 20 E7 FF AD 36 E8
C868:02 C9 44 F0 0D A9 72 A0 99
C870:C2 20 B5 C2 20 85 CA 4C 47
C878:B1 C2 A9 00 20 BD FF A9 6A
C880:0F A2 08 A0 0F 20 BA FF BB
C888:20 C0 FF A2 0F 20 C6 FF 0B
C890:A0 00 20 CF FF C9 0D F0 A5
C898:07 99 00 02 C8 4C 92 C8 99
C8A0:A9 5F 99 00 02 20 CC FF 3C
C8A8:A9 00 A0 02 20 B5 C2 A2 43
C8B0:0F 20 C9 FF A9 49 20 D2 90
C8B8:FF A9 0D 20 D2 FF 20 E7 17
C8C0:FF 4C 74 C8 20 64 C7 20 C2
C8C8:E1 C8 20 B8 C0 A9 00 A6 60
C8D0:FD A4 FE 20 D5 FF B0 88 05
C8D8:4C EB C8 A9 04 8D 88 02 A8
C8E0:00 A9 00 8D 15 D0 A9 93 88
C8E8:4C D2 FF A9 01 8D 15 D0 29
C8F0:A9 93 20 D2 FF 20 3B C4 29
C8F8:20 07 C0 4C B1 C2 F8 A9 6D
C900:00 8D 00 01 8D 01 01 E0 5A
C908:00 F0 15 CA 18 AD 00 01 9F
C910:69 01 8D 00 01 AD 01 01 0C
C918:69 00 8D 01 01 4C 07 C9 33
C920:D8 AD 01 01 09 30 8D 02 E1
C928:01 AD 00 01 29 F0 4A 4A A3
C930:4A 4A 09 30 8D 01 01 AD BF
C938:00 01 29 0F 09 30 8D 00 46
C940:01 60 38 A5 2D E9 02 85 68
C948:2D A5 2E E9 00 85 2E A9 5C
C950:01 85 61 A9 08 85 62 A9 51
C958:00 85 39 85 3A A0 00 B1 D2
C960:61 C8 11 61 F0 1B A0 02 46
C968:B1 61 85 39 C8 B1 61 85 C6
C970:3A A0 00 B1 61 48 C8 B1 D3
C978:61 85 62 68 85 61 4C 5D 98
C980:C9 18 A5 39 69 01 85 39 DA
C988:A5 3A 69 00 85 3A 20 B8 B8
C990:C0 A0 00 84 62 A0 00 18 A2
C998:A5 2D 69 25 91 2D C8 A5 42
C9A0:2E 69 00 91 2D C8 A5 39 CF
C9A8:91 2D C8 A5 3A 91 2D C8 FE
C9B0:A9 83 91 2D C8 84 61 A4 BE
C9B8:62 84 62 B1 FD AA 20 FE DF
C9C0:C8 A4 61 AD 02 01 91 2D 4D
C9C8:AD 01 01 C8 91 2D AD 00 BC
C9D0:01 C8 91 2D C8 A9 2C 91 F2
C9D8:2D C8 84 61 A4 62 C8 98 B4
C9E0:29 07 D0 D5 84 62 A4 61 9A
C9E8:88 A9 00 91 2D A0 00 B1 E1
C9F0:2D 48 C8 B1 2D 85 2E 68 A5
C9F8:85 2D E6 39 D0 02 E6 3A A1
CA00:A4 62 C0 40 D0 8F A0 00 A2
CA08:98 91 2D C8 91 2D 18 A5 97
CA10:2D 69 02 85 2D A5 2E 69 F4
CA18:00 85 2E 4C 5E A6 20 87 EE
CA20:C1 AD 2D 02 0A 6D 2D 02 2A
CA28:A8 A2 00 B9 CB CA 9D 0B 26
CA30:CB C8 E8 E0 03 D0 F4 20 6E
CA38:87 C1 AD 2D 02 0A 6D 2D CA
CA40:02 A8 A2 00 B1 FD 1D 0B 20
CA48:CB 91 FD C8 E8 E0 03 D0 16
CA50:F3 60 AD 38 02 49 01 8D F5
CA58:38 02 60 20 B8 C0 A0 00 A2
CA60:A2 3C A9 03 85 61 B1 FD CE
CA68:9D CB CA C8 E8 C6 61 A5 70
CA70:61 D0 F3 8A 38 E9 06 AA 32
CA78:10 E8 A0 3E B9 CB CA 91 6C
CA80:FD 88 10 F8 60 20 E4 FF 16
CA88:F0 FB 60 00 00 00 00 00 A1
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BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Sprite Stamp

See instructions in article on page 53 before typing in.

Program 1: Sprite Stamp

```
C000:20 FD AE 20 9E AD 20 AA 7F
C008:B1 8C 8A C2 A9 BF 8D 15 7F
C010:D0 A9 7A 8D 8C C2 8D 8E A5
C018:C2 8D 05 D0 8D 07 D0 A9 DF
C020:02 8D 27 D0 8D 29 D0 A9 54
C028:0C 8D 10 D0 8D 17 D0 8D 1A
C030:1D D0 A9 22 8D 04 D0 8D 77
C038:06 D0 A9 0E 8D F8 07 8D F2
C040:FA 07 A9 06 8D 28 D0 8D D2
C048:2A D0 A9 01 8D 3F 03 20 E7
C050:09 C4 A9 0F 8D FB 07 8D A5
C058:42 03 AD 42 03 8D F9 07 DE
C060:A9 C0 8D 90 C2 A9 5F 8D AA
C068:92 C2 A9 00 8D 98 C2 8D FA
C070:44 03 8D 94 C2 8D 48 03 AF
C078:8D 49 03 A0 00 B9 9E C2 64
C080:99 80 03 C8 C0 40 D0 F5 7A
C088:A9 FC 8D 10 D0 A9 FC 8D 85
C090:1D D0 A0 00 B9 DD C2 99 4D
C098:40 3F C8 C0 40 D0 F5 A9 0A
C0A0:21 8D 08 D0 8D 0A D0 8D E7
C0A8:0C D0 A9 A5 8D 09 D0 A9 CF
C0B0:FD 8D FC 07 A9 00 8D 2B 38
C0B8:D0 8D 2C D0 8D 2D D0 A0 FB
C0C0:00 B9 1D C3 99 80 3F C8 A6
C0C8:C0 40 D0 F5 A9 BA 8D 0B 92
C0D0:D0 A9 FE 8D FD 07 A0 00 2B
C0D8:B9 5D C3 99 C0 3F C8 C0 F5
C0E0:40 D0 F5 A9 DC 8D 0D D0 18
C0E8:A9 FF 8D FE 07 20 FA C3 53
C0F0:AD 00 DC C9 77 D0 0D AD 48
C0F8:8C C2 C9 FF B0 06 EE 8C B2
C100:C2 4C 31 C1 C9 7B D0 0A 22
C108:AD 8C C2 C9 19 90 03 CE 5A
C110:8C C2 C9 7D D0 0D AD 8E 40
C118:C2 C9 E5 B0 06 EE 8E C2 03
C120:4C 31 C1 C9 7E D0 0A AD E3
C128:8E C2 C9 33 90 03 CE 8E CC
C130:C2 AD 8C C2 8D 00 D0 AD F9
C138:8E C2 8D 01 D0 AD 00 D0 83
C140:8D 02 D0 AD 01 D0 8D 03 69
C148:D0 A5 C5 C9 17 D0 08 A9 A8
C150:00 8D 15 D0 4C FD C3 C9 92
C158:14 D0 03 20 00 C4 C9 11 34
C160:D0 03 20 12 C2 C9 3C D0 B8
C168:03 20 1E C2 A5 C5 C9 0D 4A
C170:D0 13 A9 01 8D 53 03 20 46
C178:DA C1 A9 00 8D 96 C2 20 7B
C180:CC C1 4C 85 C1 A5 C5 C9 B6
C188:0E D0 10 A9 00 8D 53 03 C3
C190:20 DA C1 A9 00 8D 96 C2 D3
C198:20 CC C1 C9 1C D0 22 EE 8B
C1A0:3F 03 A9 FF ED 3F 03 8D B9
C1A8:28 D0 8D 2A D0 8D 2B D0 AC
C1B0:8D 2C D0 8D 2D D0 20 09 EE
C1B8:C4 A9 64 8D 96 C2 20 CC 3B
C1C0:C1 A9 DC 8D 96 C2 20 CC D0
C1C8:C1 4C F0 C0 AE 96 C2 E8 A8
C1D0:A0 C8 C8 98 D0 FC 8A D0 D9
C1D8:F6 60 AD 8E C2 C9 C7 90 EB
C1E0:14 38 AD 8C C2 E9 18 8D 76
C1E8:40 03 A9 C7 ED 8E C2 8D BB
C1F0:41 03 4C 06 C2 AD 8C C2 68
C1F8:E9 17 8D 40 03 38 A9 C6 FF
C200:ED 8E C2 8D 41 03 AD 41 04
C208:03 69 32 8D 41 03 20 03 E1
C210:C4 60 20 06 C4 A9 00 8D CE
C218:96 C2 20 CC C1 60 AD 98 ED
C220:C2 CD 8A C2 D0 1A A9 C0 FA
C228:8D 90 C2 A9 5F 8D 92 C2 A4
C230:A9 00 8D 98 C2 A9 00 8D 10
C238:94 C2 8D 48 03 8D 49 03 D2
C240:AC 94 C2 A9 00 8D 9B C2 64
C248:A9 40 8D 9A C2 18 AD 48 28
C250:03 6D 9A C2 8D 48 03 AD 73
C258:49 03 6D 9B C2 8D 49 03 8C
C260:18 AD 90 C2 6D 48 03 85 B3
C268:C3 AD 92 C2 6D 49 03 85 D5
C270:C4 A2 00 B1 C3 9D C0 03 35
C278:E8 C8 E0 40 D0 F5 A9 00 76
C280:8D 96 C2 20 CC C1 EE 98 B0
C288:C2 60 12 00 F0 00 E5 00 1D
C290:C0 00 5F 00 00 00 DC 00 1C
C298:0A 00 40 00 00 00 FF FF 2B
C2A0:FC 80 00 04 80 00 04 80 91
C2A8:00 04 80 00 04 80 00 04 65
C2B0:80 00 04 80 00 04 80 00 10
C2B8:04 80 00 04 80 00 04 80 2D
C2C0:00 04 80 00 04 80 00 04 7D
C2C8:80 00 04 80 00 04 80 00 28
C2D0:04 80 00 04 80 00 04 80 45
C2D8:00 04 FF FF FC FE 00 00 43
C2E0:C6 80 00 BA 80 00 BE 98 AF
C2E8:D4 BE A5 58 BE BD 50 BA 0B
C2F0:A1 50 C6 9C D0 FE 00 00 80
C2F8:82 00 00 BE 00 00 BE 00 29
C300:00 86 A6 66 BE CA 89 BE 57
C308:8A CF 82 8A 28 FE 86 C7 D3
C310:FE 00 00 C6 00 00 BA 80 79
C318:00 BF CD B6 40 C6 D5 55 D2
C320:FA 95 55 BA 95 55 C6 8D FD
C328:56 FE 00 04 BA 00 20 BA AB
C330:00 04 D6 64 AE EE 94 A4 D8
C338:D6 F3 24 BA 84 A4 BA 74 F8
C340:A4 FE 00 00 86 00 00 BA C8
C348:04 10 BA 04 10 86 6E FB E0
C350:AE 95 57 B6 95 54 BA 64 C2
C358:D3 FE 00 00 00 00 00 00 89
C360:00 00 00 00 00 00 E0 00 A9
C368:00 A0 00 00 E6 EE 98 AC E8
C370:AA B0 EE AA B8 00 00 00 C7
C378:00 00 00 00 00 00 90 3F 60
C380:FF F0 04 00 F7 75 EA 95 C5
C388:55 52 97 55 D5 00 04 10 5E
C390:00 00 10 FF FF F0 00 00 DD
C398:00 00 00 00 00 7C 00 00 12
C3A0:41 0F 08 41 10 90 E2 98 C2
C3A8:60 83 84 40 84 42 80 FC 01
C3B0:7E 80 00 00 00 00 00 00 97
C3B8:3C 00 00 22 00 00 22 53 18
C3C0:44 44 65 54 44 85 54 78 C6
C3C8:83 38 00 00 00 00 00 00 20
C3D0:00 00 00 00 00 00 00 00 58
C3D8:00 00 00 00 00 00 00 00 60
C3E0:00 00 00 00 00 00 00 00 68
C3E8:00 00 00 00 00 00 00 00 70
C3F0:00 00 00 00 00 00 00 00 78
C3F8:00 00 4C 0C C4 4C 3A C4 5B
C400:4C AE C4 4C CA C4 4C 9D 58
C408:C6 4C 20 C4 AD 11 D0 09 B4
C410:20 8D 11 D0 AD 18 D0 09 B4
C418:08 8D 18 D0 20 20 C4 60 84
C420:A2 00 AD 3F 03 9D 00 04 37
C428:9D C8 04 9D 90 05 9D 58 39
C430:06 9D 20 07 E8 E0 C8 D0 C5
C438:EC 60 AD 11 D0 29 DF 8D 8F
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C440:11 D0 AD 18 D0 29 F7 8D 66
C448:18 D0 A9 20 A2 00 20 25 C3
C450:C4 60 A9 00 85 FE 38 A9 CB
C458:C7 ED 3D CA 48 29 F8 0A 78
C460:26 FE 0A 26 FE 0A 26 FE CB
C468:48 8D 55 CA A5 FE 8D 56 6B
C470:CA 68 0A 26 FE 0A 26 FE 88
C478:6D 55 CA 85 FD A5 FE 6D B1
C480:56 CA 85 FE AD 2D CA 29 69
C488:F8 65 FD 85 FD AD 2E CA CD
C490:65 FE 85 FE 68 29 07 65 88
C498:FD 85 FD A5 FE 69 20 85 FF
C4A0:FE AD 2D CA 29 07 AA BD DF
C4A8:25 CA 8D 4D CA 60 A9 3F 68
C4B0:85 FE A9 00 85 FD A8 85 EC
C4B8:FD 91 FD A0 3F A2 20 91 C5
C4C0:FD 88 D0 FB C6 FE CA D0 DD
C4C8:F6 60 A9 00 85 C3 85 C4 26
C4D0:8D 55 CA 8D 56 CA 8D 15 B6
C4D8:CA 8D 1D CA 8D 2E CA 8D C3
C4E0:36 CA 8D 56 CA AD 40 03 DF
C4E8:8D 2D CA 8D 05 CA AD 41 A6
C4F0:03 8D 3D CA 8D 0D CA AD 97
C4F8:42 03 8D 55 CA 0E 55 CA 6F
C500:2E 56 CA 0E 55 CA 2E 56 FA
C508:CA 0E 55 CA 2E 56 CA 0E 42
C510:55 CA 2E 56 CA 0E 55 CA 28
C518:2E 56 CA 0E 55 CA 2E 56 13
C520:CA AD 55 CA 85 C3 AD 56 C0
C528:CA 85 C4 AC 1D CA B1 C3 19
C530:29 80 F0 03 20 6D C6 EE F1
C538:2D CA B1 C3 29 40 F0 03 AE
C540:20 6D C6 EE 2D CA B1 C3 BA
C548:29 20 F0 03 20 6D C6 EE F1
C550:2D CA B1 C3 29 10 F0 03 06
C558:20 6D C6 EE 2D CA B1 C3 D2
C560:29 08 F0 03 20 6D C6 EE 04
C568:2D CA B1 C3 29 04 F0 03 ED
C570:20 6D C6 EE 2D CA B1 C3 EA
C578:29 02 F0 03 20 6D C6 EE 9A
C580:2D CA B1 C3 29 01 F0 03 F9
C588:20 6D C6 E6 C3 EE 2D CA C5
C590:B1 C3 29 80 F0 03 20 6D 54
C598:C6 EE 2D CA B1 C3 29 40 C4
C5A0:F0 03 20 6D C6 EE 2D CA 57
C5A8:B1 C3 29 20 F0 03 20 6D 66
C5B0:C6 EE 2D CA B1 C3 29 10 AC
C5B8:F0 03 20 6D C6 EE 2D CA 6F
C5C0:B1 C3 29 08 F0 03 20 6D FC
C5C8:C6 EE 2D CA B1 C3 29 04 B8
C5D0:F0 03 20 6D C6 EE 2D CA 87
C5D8:B1 C3 29 02 F0 03 20 6D B4
C5E0:C6 EE 2D CA B1 C3 29 01 CD
C5E8:F0 03 20 6D C6 E6 C3 EE D0
C5F0:2D CA B1 C3 29 80 F0 03 68
C5F8:20 6D C6 EE 2D CA B1 C3 73
C600:29 40 F0 03 20 6D C6 EE B3
C608:2D CA B1 C3 29 20 F0 03 FF
C610:20 6D C6 EE 2D CA B1 C3 8C
C618:29 10 F0 03 20 6D C6 EE BF
C620:2D CA B1 C3 29 08 F0 03 B7
C628:20 6D C6 EE 2D CA B1 C3 A4
C630:29 04 F0 03 20 6D C6 EE D4
C638:2D CA B1 C3 29 02 F0 03 B7
C640:20 6D C6 EE 2D CA B1 C3 BC
C648:29 01 F0 03 20 6D C6 AD EA
C650:05 CA 8D 2D CA CE 3D CA 6E
C658:C8 C8 C8 EE 15 CA AD 15 C8
C660:CA C9 15 F0 07 C6 C3 C6 19
C668:C3 4C 2E C5 60 8C 1D CA 47
C670:20 52 C4 AD 53 03 C9 01 51
C678:D0 0D A0 00 B1 FD 0D 4D B2
C680:CA 91 FD AC 1D CA 60 A0 D7
C688:00 38 A9 FF ED 4D CA 8D 21
C690:55 CA B1 FD 2D 55 CA 91 77
C698:FD AC 1D CA 60 20 DB C8 A4
C6A0:AD B2 C9 8D 1A C9 AD B2 C9
C6A8:C9 69 01 8D 22 C9 AD B2 B4
C6B0:C9 69 02 8D 2A C9 AD B2 1D
C6B8:C9 69 18 8D 32 C9 AD B2 28
C6C0:C9 69 19 8D 3A C9 AD B2 90
C6C8:C9 69 1A 8D 42 C9 AD B2 F8
C6D0:C9 69 30 8D 4A C9 AD B2 04
C6D8:C9 69 31 8D 52 C9 AD B2 6C
C6E0:C9 69 32 8D 5A C9 AD BA DC
C6E8:C9 8D 82 C9 4C FC C6 A0 30
C6F0:00 A9 00 99 CA C9 C8 C0 52
C6F8:40 D0 F6 60 A9 00 8D AA D2
C700:C9 20 EF C6 A0 00 8C 6A 6F
C708:C9 8C 72 C9 A2 01 AD AA A9
C710:C9 C9 00 D0 1D A9 08 8D 31
C718:9A C9 A9 0F 8D A2 C9 AD C5
C720:2A C9 8D 7A C9 A9 CA 8D A8
C728:8A C9 A9 C9 8D 92 C9 4C D7
C730:34 C8 AD AA C9 C9 01 D0 B4
C738:1D A9 01 8D 9A C9 A9 18 21
C740:8D A2 C9 AD 22 C9 8D 7A 21
C748:C9 A9 D9 8D 8A C9 A9 C9 D3
C750:8D 92 C9 4C 34 C8 AD AA 14
C758:C9 C9 02 D0 13 AD 1A C9 D9
C760:8D 7A C9 A9 F1 8D 8A C9 CD
C768:A9 C9 8D 92 C9 4C 34 C8 CA
C770:AD AA C9 C9 03 D0 1D A9 96
C778:08 8D 9A C9 A9 0F 8D A2 A6
C780:C9 AD 42 C9 8D 7A C9 A9 D8
C788:CB 8D 8A C9 A9 C9 8D 92 71
C790:C9 4C 34 C8 AD AA C9 C9 A0
C798:04 D0 1D A9 01 8D 9A C9 D9
C7A0:A9 18 8D A2 C9 AD 3A C9 2A
C7A8:8D 7A C9 A9 DA 8D 8A C9 5D
C7B0:A9 C9 8D 92 C9 4C 34 C8 13
C7B8:AD AA C9 C9 05 D0 13 AD DE
C7C0:32 C9 8D 7A C9 A9 F2 8D 9D
C7C8:8A C9 A9 C9 8D 92 C9 4C 78
C7D0:34 C8 AD AA C9 C9 06 D0 5F
C7D8:1D A9 08 8D 9A C9 A9 0F 99
C7E0:8D A2 C9 AD 5A C9 8D 7A 83
C7E8:C9 A9 CC 8D 8A C9 A9 C9 D2
C7F0:8D 92 C9 4C 34 C8 AD AA B4
C7F8:C9 C9 07 D0 1D A9 01 8D EC
C800:9A C9 A9 18 8D A2 C9 AD 40
C808:52 C9 8D 7A C9 A9 DB 8D C8
C810:8A C9 A9 C9 8D 92 C9 4C C1
C818:34 C8 AD AA C9 C9 08 F0 CC
C820:03 4C AB C8 AD 4A C9 8D FF
C828:7A C9 A9 F3 8D 8A C9 A9 B1
C830:C9 8D 92 C9 AD 9A C9 8D F1
C838:62 C9 A9 80 8D 55 CA AD AF
C840:7A C9 85 FB AD 82 C9 85 82
C848:FC AD 8A C9 85 C3 AD 92 DA
C850:C9 85 C4 AC 6A C9 B1 FB 65
C858:2D 62 C9 F0 0B 18 AC 72 E5
C860:C9 B1 C3 6D 55 CA 91 C3 4F
C868:0E 62 C9 EE 72 C9 EE 72 CC
C870:C9 EE 72 C9 AC 72 C9 CC 1D
C878:A2 C9 D0 D7 4E 55 CA E8 AB
C880:E0 09 F0 21 EE 6A C9 EE 98
C888:6A C9 EE 6A C9 AD 8A C9 2A
C890:85 C3 AD 92 C9 85 C4 A9 4C
C898:00 8D 72 C9 AD 9A C9 8D 71
C8A0:62 C9 4C 53 C8 EE AA C9 B5
C8A8:4C 04 C7 A9 CA 85 C3 A9 92
C8B0:C9 85 C4 A0 02 B1 C3 29 B2
C8B8:F8 91 C3 C8 C8 C8 C0 41 5C
C8C0:D0 F3 AD B2 C9 85 C3 AD 32
C8C8:BA C9 85 C4 A0 00 B9 CA 6A
C8D0:C9 91 C3 C8 C0 3F D0 F6 4C
C8D8:4C EF C6 A9 00 8D 62 C9 C4
C8E0:AD 42 03 8D 55 CA 8D C2 C6
C8E8:C9 0E 55 CA 2E 62 C9 0E D6
C8F0:55 CA 2E 62 C9 0E 55 CA C7
C8F8:2E 62 C9 0E 55 CA 2E 62 E8
C900:C9 0E 55 CA 2E 62 C9 0E EF
C908:55 CA 2E 62 C9 AD 55 CA 5F
C910:8D B2 C9 AD 62 C9 8D BA 3B
C918:C9 60 C0 00 00 00 00 00 C0
C920:00 00 C1 00 00 00 00 00 EB
C928:00 00 C2 00 00 00 00 00 14
C930:00 00 D8 00 00 00 00 00 DE
C938:00 00 D9 00 00 00 00 00 07
C940:00 00 DA 00 00 00 00 00 2F
C948:00 00 F0 00 00 00 00 00 F9
C950:00 00 F1 00 00 00 00 00 22
C958:00 00 F2 00 00 00 00 00 4A
C960:00 00 00 00 00 00 00 00 F3
C968:00 00 00 00 00 00 00 00 FB
C970:00 00 00 00 00 00 00 00 04
C978:00 00 F0 00 00 00 00 00 2A
C980:00 00 03 00 00 00 00 00 74
C988:00 00 F3 00 00 00 00 00 9A
C990:00 00 C9 00 00 00 00 00 5D
C998:00 00 01 00 00 00 00 00 4C
C9A0:00 00 18 00 00 00 00 00 37
C9A8:00 00 09 00 00 00 00 00 5D
C9B0:00 00 C0 00 00 00 00 00 5C
C9B8:00 00 03 00 00 00 00 00 AC
C9C0:00 00 0F 00 00 00 00 00 36
C9C8:00 00 00 00 00 00 00 00 5C
C9D0:00 00 00 00 00 00 00 00 64
C9D8:00 00 00 00 00 00 00 00 6C
C9E0:00 00 00 00 00 00 00 00 74
C9E8:00 00 00 00 00 00 00 00 7C
C9F0:00 00 00 00 00 00 00 00 84
C9F8:00 00 00 00 00 00 00 00 8C
CA00:00 00 00 00 00 57 00 00 F2
CA08:00 00 00 00 00 B3 00 00 6C
CA10:00 00 00 00 00 15 00 00 F9
CA18:00 00 00 00 00 3C 00 00 9E
CA20:00 00 00 00 00 80 40 20 58
CA28:10 08 04 02 01 57 00 00 CD
CA30:00 00 00 00 00 00 00 00 C5
CA38:00 00 00 00 00 9E 00 00 48
CA40:00 00 00 00 00 00 00 00 D5
CA48:00 00 00 00 00 10 00 00 1E
CA50:00 00 00 00 00 EF 01 00 A7
CA58:00 00 00 00 00 00 00 00 ED
```

Program 2: Starter

```
KC 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
XC 20 POKE 53280,0:POKE 53281,
      0:PRINT"{CLR}{CYN}
      {3 SPACES}COPYRIGHT 1987
       COMPUTE! PUB., INC."
RD 30 PRINTTAB(10)"ALL RIGHTS
      {SPACE}RESERVED{2 DOWN}"
XQ 40 IF L$<>"" THEN100
CA 50 INPUT"LOAD FILE (Y/N)";A
      $
DS 60 IF LEFT$(A$,1)="N" THEN1
      00
HR 70 PRINT"{CLR}*** LOAD ***
      {DOWN}"
QR 80 INPUT"FILENAME";L$
BA 90 LOAD L$,8,1
HM 100 SYS 49152,S:REM S IS #
       {SPACE}OF SHAPES
PF 110 PRINT"{CLR}*** SAVE ***
       {DOWN}"
QX 120 REM CLEAR BUFFER
RC 130 FORI=1TO10:POKE630+I,0:
       NEXT
QE 140 INPUT"FILENAME [RETURN
       {SPACE}TO ABORT]";F$
AA 150 IF F$="" THEN PRINT"STO
       P":END
EX 160 L=LEN(F$)
JP 170 FOR X=1 TO L
KJ 180 POKE 24559+X,ASC(MID$(F
       $,X,1))
GR 190 NEXT
DD 200 POKE 780,4:POKE 781,8:P
       OKE 782,255
FE 210 SYS 65466
EC 220 POKE 780,L:POKE 781,240
       :POKE 782,95
SK 230 SYS 65469
PC 240 POKE 251,0:POKE 252,32
SM 250 POKE 780,251:POKE 781,6
       3
QP 260 POKE 782,63:SYS 65496
```

Program 3: Sprite Data Skeleton

```
DR 10 X=24576
JG 20 READ A:IF A=-1 THEN POKE
      850,10:END
CG 30 POKE X,A:X=X+1:GOTO20
DE 40 REM
JK 50000 DATA -1
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Commodore Relative Files

Article on page 64.

Relative File Demo

```
BE 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS INC. -
      {SPACE}ALL RIGHTS RESERV
      ED
SB 20 PRINT"{CLR}{2 SPACES}COP
      YRIGHT 1987 COMPUTE! PUB
      ., INC."
MA 30 PRINTTAB(9)"ALL RIGHTS R
      ESERVED{2 DOWN}"
BM 40 OPEN 15,8,15
JE 50 OPEN 1,8,2,"0:TESTREL"
PF 60 INPUT#15,E,E$,E1,E2
JD 70 IF E=0 GOTO230
AQ 80 CLOSE 1
FD 90 IF E<>62 THEN PRINT E;E$
      ;E1;E2:STOP
RQ 100 PRINT"CREATING FILE"
AM 110 OPEN 1,8,2,"0:TESTREL,L
      ,"+CHR$(33)
XM 120 INPUT#15,E,E$,E1,E2
EH 130 IF E<>0 THEN CLOSE 1:PR
      INT E,E$,E1,E2:STOP
PK 140 PRINT#15,"P"+CHR$(98)+C
      HR$(10)+CHR$(0)+CHR$(1)
PJ 150 INPUT#15,E,E$,E1,E2
EG 160 IF E<>50 THEN CLOSE 1:P
      RINT E;E$;E1;E2:STOP
RC 170 PRINT#1,CHR$(255);
HR 180 INPUT#15,E,E$,E1,E2
FH 190 CLOSE 1
FP 200 IF E<>0 THEN PRINT E;E$
      ;E1;E2:STOP
HB 210 OPEN 1,8,2,"0:TESTREL"
AA 220 GOTO240
XG 230 PRINT"FILE ALREADY EXIS
      TS"
BP 240 PRINT"{2 DOWN}1. READ A
      LL RECORDS"
MH 250 PRINT"2. WRITE RECORD"
QK 260 PRINT"3. QUIT"
JE 270 INPUT"{DOWN}WHICH (1, 2
       OR 3)";X:PRINT
GH 280 ON X GOTO300,440,710
QG 290 GOTO240
RS 300 R=0
SE 310 R=R+1:F=0:X=0
SE 320 H=INT(R/256):L=R-H*256
QD 330 PRINT#15,"P"+CHR$(98)+C
      HR$(L)+CHR$(H)+CHR$(1)
CE 340 INPUT#15,E,E$,E1,E2
GP 350 IF E=50 GOTO240
HM 360 IF E<>0 THEN PRINT E;E$
      ;E1;E2:GOTO710
BJ 370 INPUT#1,X$:SW=ST
GM 380 IF X$=CHR$(255) THEN PR
      INT"RECORD";R;"<EMPTY>"
      :GOTO310
FP 390 IF F=0 THEN PRINT"RECOR
      D";R;":"
AD 400 F=F+1:IF SW=0 THEN X=1
JS 410 PRINT"{5 SPACES}FIELD";
      F;": ";X$
SH 420 IF SW=0 GOTO370
XR 430 GOTO310
BG 440 INPUT"WRITE TO RECORD N
      UMBER";R
JC 450 IF R<1 OR R<>INT(R) GOT
      O440
AK 460 IF R>40 THEN PRINT "TOO
       BIG!":GOTO570
RS 470 H=INT(R/256):L=R-H*256
QK 480 PRINT#15,"P"+CHR$(98)+C
      HR$(L)+CHR$(H)+CHR$(1)
CC 490 INPUT#15,E,E$,E1,E2
ES 500 IF E=50 THEN PRINT"A NE
      W ONE!"
PM 510 INPUT"HOW MANY FIELDS (
      1-3)";N
BK 520 IF N<1 OR N>3 GOTO510
KG 530 A$=""
JH 540 PRINT"ENTER DATA:"
HX 550 FOR J=1 TO N
FH 560 IF N<>1 THEN PRINT"FIEL
      D";J;
EP 570 INPUT B$
FJ 580 A$=A$+B$+CHR$(13)
SQ 590 NEXT J
PK 600 A$=LEFT$(A$,LEN(A$)-1)
GS 610 PRINT#1,A$;
JM 620 INPUT#15,E,E$,E1,E2
MF 630 IF E<>0 THEN PRINT E;E$
      ;E1;E2
JD 640 CLOSE 1
QJ 650 INPUT#15,E,E$,E1,E2
SD 660 IF E<>0 THEN PRINT E;E$
      ;E1;E2
FH 670 OPEN 1,8,2,"0:TESTREL"
AS 680 INPUT#15,E,E$,E1,E2
CB 690 IF E<>0 THEN PRINT E;E$
      ;E1;E2
AS 700 GOTO240
KH 710 CLOSE 1
FJ 720 CLOSE 15
```

Bounty Hunter

Article on page 29.

```
BE 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS INC. -
      {SPACE}ALL RIGHTS RESERV
      ED
DJ 20 POKE53269,0:SP=53248:N=5
      4272:SP$="{15 SPACES}":P
      OKE53281,6:POKE53280,10
AM 30 PRINT"{CLR}{3 DOWN}{RVS}
      {4 SPACES}COPYRIGHT 1987
       COMPUTE! PUB., INC.
      {2 SPACES}";
RX 40 PRINT"{RVS}{11 SPACES}AL
      L RIGHTS RESERVED
      {10 SPACES}{OFF}{8 DOWN}";
SB 50 DIMST$(50),CA$(50),NB$(5
      0),AB(50),PK(50),A$(50),
      SX(50),SY(50),CP(50),ST(
      50)
QA 60 C=C+1:IFC=49THEN80
AJ 70 READST$(C):READCA$(C):RE
      ADSX(C):READSY(C):READNB
      $(C):GOTO60
QP 80 FORX=842TO881:READA:POKE
      X,A:NEXTX
EK 90 FORX=906TO945:READA:POKE
      X,A:NEXTX
KS 100 FORX=970TO1009:READA:PO
      KEX,A:NEXTX
XA 110 POKE2040,13:POKE2041,14
      :POKESP+28,3
PR 120 POKE53285,10:POKE53288,
      2:POKE53287,9:POKESP+16
      ,0
SK 130 POKESP,120:POKESP+1,170
      :POKESP+2,240:POKESP+3,
      170:POKE53269,3:XZ=-1
SA 140 PRINTTAB(214)"CHOOSE ON
      E:"SPC(68)"1 - BOUNTY H
      UNTER"SPC(63)"2 - COUNT
       DOWN
QD 150 PRINTTAB(247)"BOUNTY HU
      NTER"SPC(6)"CROOK"
HX 160 GETA$:R=RND(1):IFA$<"1"
      ORA$>"2"THEN160
BR 170 F=VAL(A$):IFF=1THEN210
AA 180 POKESP+3,250:PRINT"
      {CLR}"TAB(253)"MINUTES
      {SPACE}(1-5)"
MF 190 GETA$:IFA$<"1"ORA$>"5"T
      HEN190
FQ 200 SC=VAL(A$):SC=SC*60+1
GE 210 PRINT"{CLR}"TAB(215)"CH
      OOSE ONE:"SPC(69)"1 - S
      TATES"SPC(70)"2 - CAPIT
      ALS"
HE 220 GETA$:IFA$<"1"ORA$>"2"T
      HEN220
GM 230 IFA$="1"THEN250
JF 240 FORX=1TO48:ST$(X)=CA$(X
      ):NEXTX
KS 250 PRINT"{CLR}"SPC(214)"1
      {SPACE}- VISIBLE "SPC(6
      8)"2 - INVISIBLE
PM 260 GETA$:IFA$<"1"ORA$>"2"T
      HEN260
XP 270 E=VAL(A$):IFF=2THEN1480
PJ 280 PRINTTAB(93)"DIFFICULTY
       (1-3)
GM 290 RC=INT(48*RND(1))+1:RR=
      RC
CA 300 GETA$:IFA$<"1"ORA$>"3"T
      HEN300
DM 310 B=VAL(A$):B=4-B:POKESP+
      1,250:POKESP+3,250
JD 320 PRINT"{CLR}{CYN}"TAB(20
      5)"THE CROOK IS IN "ST$
      (RC):FORX=1TO2000:NEXTX
HQ 330 GOTO1480
MJ 340 PRINT"{CLR}{CYN}";:POKE
      SP+3,250
HF 350 SX(18)=290:SY(18)=173:S
      X(19)=275:SY(19)=70:SX(
      20)=290:SY(20)=140
XH 360 SX(21)=280:SY(21)=106:S
      X(22)=285:SY(22)=200
HM 370 IFE=2THEN630
SG 380 PRINT" {RVS}O{6 Y}OO
      {12 Y}O{6 Y}P{4 Y}{*}
HJ 390 PRINT"{RVS}O{OFF}{*}
      {RVS}{6 SPACES}{H}M
      {12 SPACES}{H}
      {6 SPACES}{N}{6 SPACES}
      {OFF}£
JQ 400 PRINT"{RVS}{H}
      {7 SPACES}{H} {H}
      {11 SPACES}{H}
      {6 SPACES}{N}{5 SPACES}
      {OFF}£
DA 410 PRINT"{RVS}OM{3 P}N
      {2 Y}{H} M{11 P}O{7 Y}
      {H}{4 SPACES}{OFF}
QG 420 PRINT"{RVS}{H}
      {7 SPACES}{H}{4 SPACES}
      {H}{8 SPACES}{H}
      {7 SPACES}{H}{4 SPACES}
      {*}
AE 430 PRINT"{RVS}{H}
      {7 SPACES}{H}{4 SPACES}
      {H}{8 SPACES}{H}
      {7 SPACES}{H}{5 SPACES}
      {*}
AK 440 PRINT"{RVS}L{7 P}L{4 P}
      {H}{8 SPACES}L{6 P}'O
      {6 Y}
RC 450 PRINT"{RVS}{H}
      {2 SPACES}{N}{6 SPACES}
      {H}{2 SPACES}{H}
      {8 SPACES}{H}{6 SPACES}
      M{H}{6 SPACES}P
```

```
KD 460 PRINT"{RVS}{H}
       {2 SPACES}{N}{6 SPACES}
       {H}{2 SPACES}L{8 P}L{P}
       {6 SPACES}M{6 SPACES}
       {N}
KC 470 PRINT"{RVS}{H}
       {2 SPACES}{N}{6 SPACES}
       {H}{4 SPACES}{H}
       {8 SPACES}{H}{5 SPACES}
       {N}{6 SPACES}{OFF}
JP 480 PRINT"{RVS}{H}
       {2 SPACES}{N}{6 SPACES}
       {H}{4 SPACES}{H}
       {8 SPACES}L{5 P}@{6 Y}
RC 490 PRINT"{RVS}{H}
       {3 SPACES}M{5 SPACES}
       {H}{4 SPACES}{H}
       {8 SPACES}{H}{6 SPACES}
       M{5 SPACES}{OFF}
KM 500 PRINT"{*}{RVS}
       {4 SPACES}M{4 SPACES}
       {H}{4 SPACES}{H}
       {8 SPACES}{H}{6 SPACES}
       {N}{6 SPACES}{OFF}
AR 510 PRINT" {*}{RVS}
       {4 SPACES}M{3 SPACES}
       {H}{4 SPACES}{H}
       {8 SPACES}{H}{6 SPACES}
       {N}{6 SPACES}{*}
MM 520 PRINT"{2 SPACES}{*}
       {RVS}{4 SPACES}MO{6 Y}O
       {6 Y}P{9 Y}L{6 P}
GM 530 PRINT"{3 SPACES}{*}
       {RVS}{4 SPACES}M
       {6 SPACES}{H}{6 SPACES}
       {N}{3 Y}{H}{5 SPACES}
       {H}{5 SPACES}{OFF}£
CS 540 PRINT"{4 SPACES}{*}
       {RVS}{3 SPACES}N
       {6 SPACES}{H}{6 SPACES}
       {N}{3 SPACES}M
       {5 SPACES}{H}{5 SPACES}
       "
GE 550 PRINT"{8 SPACES}{*}
       {RVS}{6 SPACES}{H}
       {6 SPACES}{N}{4 SPACES}
       {5 Y}{H}{5 SPACES}{OFF}
KX 560 PRINT"{9 SPACES}{*}
       {RVS}{5 SPACES}{H}{6 P}
       @{9 SPACES}O{5 Y}
HK 570 PRINT"{WHT}MOVE?{CYN}
       {5 SPACES}{*}{RVS}
       {4 SPACES}L{OFF} {*}
       {RVS}{14 SPACES}{H}
       {5 SPACES}{OFF}
GX 580 PRINT"{18 SPACES}{*}
       {RVS}{13 SPACES}{H}
       {2 SPACES}{RVS}
       {2 SPACES}{OFF}£
XP 590 PRINT"{3}O{10 Y}P{CYN}
       {SPACE}{YEL}SCORE:{CYN}
       {*}{RVS}{11 SPACES}N
       {7 SPACES}{OFF}
RG 600 PRINT"{3}{H}{10 SPACES}
       {N}{CYN}{8 SPACES}{*}£
       {*}{RVS}{4 SPACES}{OFF}
       £{9 SPACES}{*}{RVS}{*}
EX 610 PRINT"{3}{H}{10 SPACES}
       {N}{CYN}{11 SPACES}{*}
       {RVS}{2 SPACES}{OFF}£
       {11 SPACES}{*}{RVS}{*}
       {OFF}";
BQ 620 PRINT"{3}L{10 P}@{CYN}
       {12 SPACES}{*}£";
JM 630 IFF=2THENGOSUB2740:PRIN
       TLA;
KE 640 IFF=2ORRC>22THEN670
PC 650 IFSX(RC)>255THENK=255:P
       OKESP+16,3:CX=2
AD 660 POKESP+2,SX(RC)-K:POKES
       P+3,SY(RC):K=0
QD 670 GOSUB1590:GOTO1010
DJ 680 PRINT"{CLR}";:POKESP+3,
       250
HM 690 SX(18)=57:SY(18)=174:SX
       (19)=40:SY(19)=55:SX(20
       )=60:SY(20)=138
DF 700 SX(21)=44:SY(21)=93:SX(
       22)=57:SY(22)=205:IFE=2
       THEN960
FQ 710 PRINT"{RVS}{7 SPACES}
       {OFF}£{28 SPACES}{RVS}
       O{Y}
GS 720 PRINT"{RVS}{6 SPACES}N
       {SPACE}M{P}{3 SPACES}
       {*}{OFF}{WHT}MOVE{CYN}
       {16 SPACES}{RVS}£
       {2 SPACES}{OFF}
EH 730 PRINT"{RVS}{6 SPACES}
       {H}{3 SPACES}MN{OFF}
       {RVS}£{2 SPACES}{*}
       {OFF}{11 SPACES}{RVS}
       {H}{2 SPACES}{H} {H}{N}
       {3 SPACES}{*}
DM 740 PRINT"{RVS}{6 SPACES}M
       {5 SPACES}{OFF} {RVS}
       {3 SPACES}{OFF}£
       {11 SPACES}{RVS}{H}
       {2 SPACES}{H} {H}{N}
       {OFF}£
GQ 750 PRINT"{RVS}{7 Y}{H}
       {4 SPACES}{OFF} {RVS}
       {4 SPACES}{OFF}
       {7 SPACES}{RVS}£
       {6 SPACES}{H}N N
QA 760 PRINT"{RVS}{7 SPACES}L
       {4 SPACES}{OFF} {RVS}
       {4 SPACES}{OFF}
       {6 SPACES}{RVS}£
       {7 SPACES}O{2 Y} {OFF}
PX 770 PRINT"{*}{RVS}
       {7 SPACES}O{3 Y}{OFF}
       {RVS}{2 Y}O{Y}{*}{OFF}
       {SPACE}{RVS}£{Y}O{7 Y}
       M O{Y}PM{*}{OFF}{G}
MK 780 PRINT" {RVS}{7 SPACES}
       {H}{3 SPACES}{H}
       {2 SPACES}{H}{5 SPACES}
       {H}{7 SPACES}NM{H} {N}
       {SPACE}{OFF}
AB 790 PRINT" {RVS}{6 P}O
       {4 SPACES}{H}{2 SPACES}
       {H}{4 SPACES}NL{7 P}L
PF 800 PRINT" {*}{RVS}
       {5 SPACES}M{4 SPACES}
       {H}{2 SPACES}L
       {3 SPACES}N{2 SPACES}L
       {3 P}{2 SPACES}{N} {*}
HG 810 PRINT"{2 SPACES}{*}
       {RVS}{5 SPACES}M
       {3 SPACES}{H} N M{P}N
       {4 SPACES}N{2 SPACES}MN
       {H}{Y}P
XC 820 PRINT"{3 SPACES}{RVS}
       {6 SPACES}{H}{2 SPACES}
       LN{4 SPACES}M{2 P}N{Y}
       {5 SPACES}{2 Y}P{OFF}
       {2 SPACES}{YEL}SCORE:
       {CYN}
XS 830 PRINT"{3 SPACES}{RVS}
       {6 SPACES}M{P}N
       {6 SPACES}N {@}
       {9 SPACES}{N}
FK 840 PRINT"{3 SPACES}{RVS}
       {6 SPACES}N{2 SPACES}
       {I}{U}{6 Y}N{10 Y}
FJ 850 PRINT"{3 SPACES}{RVS}RR
       RRRRO{2 Y}{7 SPACES}N
       {11 SPACES}{OFF}
DH 860 PRINT"{3 SPACES}{RVS}
       {5 SPACES}N{4 Y}O{4 Y}O
       {2 Y}O{2 Y}M{4 P}
       {2 SPACES}{OFF}
CF 870 PRINT"{3 SPACES}{RVS}
       {5 SPACES}{H}{4 SPACES}
       {H}{4 SPACES}{H}
       {2 SPACES}M{7 SPACES}M
       {OFF}£
GR 880 PRINT"{3 SPACES}{RVS}
       {5 SPACES}{H}{4 SPACES}
       {H}{4 SPACES}{H}
       {3 SPACES}{Y}M{P}
       {4 SPACES}{OFF}£
JQ 890 PRINT"{3 SPACES}{RVS}
       {5 P}{H}{4 SPACES}{H}
       {4 SPACES}{H}{6 SPACES}
       M{2 SPACES}{OFF}£
XF 900 PRINT"{3 SPACES}{RVS}
       {H}{4 SPACES}{H}
       {4 SPACES}{H}{4 SPACES}
       {H}{7 SPACES}M{OFF}£
       {3}O{10 Y}P{CYN}";
HS 910 PRINT"{3 SPACES}{RVS}
       {H}{3 SPACES}N
       {5 SPACES}{H} {3 P}L
       {7 P}{OFF}£ {3}{H}
       {10 SPACES}{N}{CYN}";
EB 920 PRINT"{2 SPACES}{RVS}£
       {4 SPACES}{3 Y}P
       {2 SPACES}{H} {H}
       {10 SPACES}{*}{OFF} {3}
       {H}{10 SPACES}{N}{CYN}"
       ;
HK 930 PRINT"{2 SPACES}{RVS}
       {7 SPACES}{*}{OFF}
       {8 SPACES}{*}{RVS}
       {4 SPACES}{OFF} {*}
       {RVS}{2 SPACES}{OFF}
       {3}L{10 P}@{CYN}";
CS 940 PRINT"{9 SPACES}{*}
       {RVS}{*}{OFF}
       {14 SPACES}{*}{RVS} {*}
SQ 950 PRINT"{10 SPACES}{*}
       {15 SPACES}{*}{RVS} {*}
       {OFF}";
GC 960 CX=0:POKESP+16,0:IFF=2T
       HENGOSUB2740:PRINTLA;
XM 970 IFF=2ORRC<18THEN1000
EX 980 IFSX(RC)>255THENK=255:P
       OKESP+16,2:CX=2
DJ 990 POKESP+2,SX(RC)-K:POKES
       P+3,SY(RC):K=0
PJ 1000 GOSUB1590
DE 1010 IFMP=1THENYY=20:XX=0:G
       OSUB2450:PRINTSP$:PRIN
       T"{UP}";
XA 1020 IFMP=2THENPRINT"{HOME}
       "TAB(60)SP$:PRINT"
       {HOME}"TAB(60);
KG 1030 Y=0:R1=R
EP 1040 IFAN$<>""THENDA=1
PM 1050 IFG=1THENG=0:GOTO1360
EK 1060 AN$=""
DJ 1070 IFDA=1THENRETURN
GM 1080 IFF=2THEN2610
HE 1090 GOTO2120
FJ 1100 IFY>0THEN1200
JC 1110 IFA$<>" "THEN1180
DS 1120 IFXZ>LEN(NB$(R))-2THEN
       XZ=-1
QQ 1130 XZ=XZ+2:NM$=MID$(NB$(R
       ),XZ,2):NM=VAL(NM$):PR
       INTST$(NM):X=0
RA 1140 X=X+1
CH 1150 GETA$:IFA$=CHR$(13)THE
       NAN$=ST$(NM):G=1:GOSUB
       2810:GOTO1170
JC 1160 IFX<30THEN1140
FF 1170 DA=1:GOTO1010
DF 1180 IFA$<>CHR$(13)THEN1200
MB 1190 PRINT"{RVS}"ST$(HM):FO
       RX=1TO200:NEXTX:GOTO10
       10
CK 1200 IFA$=" "ANDA$(Y)=" "TH
       ENRETURN
HF 1210 IFA$<>"{RIGHT}"THEN127
       0
```

```
DH 1220 IFR<18ORR>22THEN1270
AQ 1230 POKESP+1,250:POKESP+3,
        250:DA=1
AG 1240 IFMP=1THENMP=2:GOTO126
        0
HG 1250 MP=1
GS 1260 ONMPGOTO340,680
MX 1270 IFA$=CHR$(13)THEN1330
FM 1280 IFA$=CHR$(20)ANDY=0THE
        NRETURN
QF 1290 IFA$=CHR$(20)THENPRINT
        "{LEFT} {LEFT}";:A$(Y)
        ="":Y=Y-1
SH 1300 IF(A$<"A"ORA$>"Z")ANDA
        $<>" "ANDA$<>"."THENRE
        TURN
RJ 1310 IFY=14THENRETURN
FS 1320 PRINTA$;:Y=Y+1:A$(Y)=A
        $:RETURN
QM 1330 GOSUB2810
HE 1340 IFA$(Y)=" "THENY=Y-1
PF 1350 FORX=1TOY:AN$=AN$+A$(X
        ):A$(X)="":NEXTX
GE 1360 ZY=LEN(NB$(R))
AB 1370 ZZ=-1
QM 1380 ZZ=ZZ+2
ER 1390 MI$=MID$(NB$(R),ZZ,2):
        MI=VAL(MI$)
KS 1400 IFAN$=ST$(MI)THENR=MI:
        GOTO1500
RM 1410 IFZZ<ZY+1THEN1380
CQ 1420 P=0
SA 1430 FORZX=1TO48:IFAN$=ST$(
        ZX)THENP=1
RE 1440 NEXTZX
EM 1450 U=2:W=10
JJ 1460 IFP=1THENGOSUB2810:PRI
        NT"{YEL}{3 SPACES}NOT
        {SPACE}A {DOWN}
        {8 LEFT}NEIGHBOR{CYN}"
        ;:GOSUB2840:GOTO1010
HJ 1470 GOSUB2810:PRINT"{YEL}T
        RY AGAIN{CYN}";:GOSUB2
        840:GOTO1010
JX 1480 R=INT(48*RND(1))+1:R1=
        R:IFR=RCTHEN1480
BX 1490 HM=R:TE=INT(TI/60)
MF 1500 IFMP=1ANDR<23THEN670
AE 1510 IFMP=2ANDR>17THEN1000
FJ 1520 POKESP+1,250:POKESP+3,
        250
JS 1530 IFR<18ORR>22THEN1560
SP 1540 IFRC>22THENMP=2:GOTO68
        0
RP 1550 MP=1:GOTO340
RJ 1560 IFR>22THENMP=2:GOTO680
GF 1570 IFR<23THENMP=1:GOTO340
BC 1580 IF(MP=1ANDRC>22)OR(MP=
        2ANDRC<18)THENPOKESP+3
        ,250
KX 1590 IFSX(R)<256THENBX=0
MJ 1600 IFSX(R)>255THENBX=1
MX 1610 IFF=1THEN1660
BM 1620 IFST(R)=0THENST(R)=1:L
        A=LA+1:GOSUB2740:PRINT
        LA;:GOTO1660
CF 1630 IFMP=1THENXX=2:YY=22
MS 1640 IFMP=2THENXX=29:YY=20
DF 1650 GOSUB2450:PRINT"{YEL}A
        LREADY{DOWN}{7 LEFT}CH
        OSEN{CYN}";:U=3:W=13:G
        OSUB2840
XP 1660 IFSX(R)>255THENX2=255
XE 1670 POKESP+1,250
FJ 1680 POKESP,SX(R)-X2:X2=0:P
        OKESP+16,BX+CX:POKESP+
        1,SY(R)
SK 1690 IFF=1THENGOSUB2740:PRI
        NT"{6 SPACES}{7 LEFT}$
        "10000-J;
DB 1700 IFEA=1ANDR=HMTHENGOSUB
        2520
BJ 1710 IFSA=1ORR<>RCTHENRETUR
        N
QC 1720 GOSUB2810:PRINT"{YEL}
        {SPACE}GOT HIM!":U=5:W
        =80:GOSUB2840:FORL=1TO
        100:NEXTL
CS 1730 GOSUB2810:PRINT"{WHT}
        {SPACE}GO HOME!{CYN}";
QF 1740 POKE2041,15:EA=1:R8=1:
        R9=1:MA=1:SA=1:POKESP+
        3,250:RETURN
FA 1750 DATAWASHINGTON,OLYMPIA
        ,45,55,0702,IDAHO,BOIS
        E,95,83,010705041009
KD 1760 DATASOUTH DAKOTA,PIERR
        E,223,80,061904122105
QP 1770 DATAWYOMING,CHEYENNE,1
        55,93,020503121110,MON
        TANA,HELENA,140,58,020
        40603
CB 1780 DATANORTH DAKOTA,BISMA
        RCK,220,55,051903,OREG
        ON,SALEM,45,83,0108090
        2
XD 1790 DATACALIFORNIA,SACRAME
        NTO,30,125,070913
KA 1800 DATANEVADA,CARSON CITY
        ,70,125,0807021013
JS 1810 DATAUTAH,SALT LAKE CIT
        Y,113,125,090204111413
BR 1820 DATACOLORADO,DENVER,17
        0,135,10131417161204
CE 1830 DATANEBRASKA,LINCOLN,2
        30,112,040321201611
BK 1840 DATAARIZONA,PHOENIX,10
        5,175,0809101114
HP 1850 DATANEW MEXICO,SANTA F
        E,165,175,1310111715,T
        EXAS,AUSTIN,226,195,14
        171822
AB 1860 DATAKANSAS,TOPEKA,235,
        140,11122017
DS 1870 DATAOKLAHOMA,OKLAHOMA
        {SPACE}CITY,247,165,11
        1620181514
RG 1880 DATAARKANSAS,LITTLE RO
        CK,57,174,172042442215
BA 1890 DATAMINNESOTA,ST. PAUL
        ,40,55,06032124
XH 1900 DATAMISSOURI,JEFFERSON
         CITY,60,138,161221274
        1421817
AP 1910 DATAIOWA,DES MOINES,44
        ,93,120319242720,LOUIS
        IANA,BATON ROUGE,57,20
        5,151844
SE 1920 DATAMICHIGAN,LANSING,1
        32,75,242526,WISCONSIN
        ,MADISON,90,75,1923272
        1
HB 1930 DATAINDIANA,INDIANAPOL
        IS,122,110,23272641,OH
        IO,COLUMBUS,153,110,25
        41402328
EX 1940 DATAILLINOIS,SPRINGFIE
        LD,92,115,2124254120
BJ 1950 DATAPENNSYLVANIA,HARRI
        SBURG,215,100,26403836
        2937
MB 1960 DATANEW YORK, ALBANY,2
        38,80,2836353330,VERMO
        NT,MONTPELIER,267,70,2
        93331
CQ 1970 DATANEW HAMPSHIRE,CONC
        ORD,285,65,333032,MAIN
        E,AUGUSTA,305,55,31
PS 1980 DATAMASSACHUSETTS,BOST
        ON,287,85,2930313534
SP 1990 DATARHODE ISLAND,PROVI
        DENCE,290,100,3335
GK 2000 DATACONNECTICUT,HARTFO
        RD,270,97,293334,NEW J
        ERSEY,TRENTON,255,105,
        292837
PD 2010 DATADELAWARE,DOVER,252
        ,118,382836
GA 2020 DATAMARYLAND,ANNAPOLIS
        ,228,118,37284039
RJ 2030 DATAVIRGINIA,RICHMOND,
        218,133,3840414243
MR 2040 DATAWEST VIRGINIA,CHAR
        LESTON,178,125,2628383
        941
HQ 2050 DATAKENTUCKY,FRANKFORT
        ,138,135,2027252640394
        2
JJ 2060 DATATENNESSEE,NASHVILL
        E,140,153,182041394347
        4644
AJ 2070 DATANORTH CAROLINA,RAL
        EIGH,218,156,42394547
JQ 2080 DATAMISSISSIPPI,JACKSO
        N,98,185,22184246
FJ 2090 DATASOUTH CAROLINA,COL
        UMBIA,228,180,4743
EE 2100 DATAALABAMA,MONTGOMERY
        ,138,185,44424748
AS 2110 DATAGEORGIA,ATLANTA,18
        5,190,4642434548,FLORI
        DA,TALLAHASSEE,180,216
        ,4746
BM 2120 RR=RC:IFEA=1THENV3=200
        0
GM 2130 FORX1=1TOLEN(NB$(RR))S
        TEP2
PM 2140 GETA$:IFA$<>""THENPRIN
        T" {LEFT}";:GOSUB1100
CG 2150 M$=MID$(NB$(RR),X1,2):
        M=VAL(M$):R8=1:R9=1
MA 2160 V1=ABS(SY(R)-SY(M))
AD 2170 IFEA=0AND(RC<18ORRC>22
        )THENR8=INT(3*RND(1))+
        1:R9=INT(2*RND(1))+1
AD 2180 IFMP=1ANDM>22THENV=255
        -SX(R)+SX(M):GOTO2210
SE 2190 IFMP=2ANDM<18THENV=SX(
        R)+255-SX(M):GOTO2210
RR 2200 V=ABS(SX(R)*R8-SX(M)*R
        9)
KB 2210 FORXY=1TOLEN(NB$(R))ST
        EP2
XG 2220 MN$=MID$(NB$(R),XY,2):
        MN=VAL(MN$)
BB 2230 IFMN=MTHENV=V-1000
BE 2240 GETA$:IFA$<>""THENPRIN
        T" {LEFT}";:GOSUB1100
EG 2250 NEXTXY
RR 2260 PRINT"{RVS} {OFF}
        {LEFT}";
RB 2270 V2=V+V1:IFV2<0THENV2=I
        NT(4*RND(1))
GF 2280 IFEA=0THEN2310
FG 2290 IFV2<V3THENV3=V2:RD=M
AB 2300 GOTO2320
FH 2310 IFV2>V3THENV3=V2:RD=M
ED 2320 NEXTX1
DH 2330 D=D+1:IFD<BTHEN2120
QX 2340 GETA$:IFA$<>""THENPRIN
        T" {LEFT}";:GOSUB1100
HE 2350 D=0:RC=RD:PRINT"
        {LEFT}";:V3=0
HB 2360 IFMA=1ANDEA=1THENRC=IN
        T(48*RND(1))+1:KC=RC:M
        A=0
BB 2370 POKESP+3,250
BA 2380 IFEA=0THENJ=J+100:U=1:
        W=40:GOSUB2840
SQ 2390 IF(MP=1ANDRC>22)OR(MP=
        2ANDRC<18)THEN2120
EM 2400 IFSX(RC)<256THENCX=0
KM 2410 IFSX(RC)>255THENCX=2:X
        3=255
SA 2420 POKESP+16,BX+CX:POKESP
        +2,SX(RC)-X3:X3=0:POKE
        SP+3,SY(RC)
```

```
HS 2430 IFSA=1ANDRC=RTHENGOSUB
        2570
MJ 2440 GOTO2120
KM 2450 POKE781,YY:POKE782,XX:
        POKE783,48:SYS65520:XX
        =0:YY=0:RETURN
PA 2460 DATA168,0,2,170,0,10,1
        70,128,042,170,160,41,
        85,160,41,221,160,101,
        17,100
CA 2470 DATA101,101,100,21,101
        ,80,21,85,80,21,1,80,5
        ,69,64,1,85,0,0,84,252
        ,0,3,255
ES 2480 DATA0,15,223,192,61,85
        ,240,61,85,240,63,223,
        240,127,255,244,117,23
        7,116,53
JJ 2490 DATA101,112,52,204,112
        ,7,3,64,3,87,0,0,84,0,
        0,16,84,0,1,85,0,13,85
        ,192,61
FB 2500 DATA85,240,61,85,240,6
        3,223,240,127,255,244,
        117,237,116,53,101,112
        ,61
FX 2510 DATA221,240,15,3,192,1
        5,84,192,3,223,0,0,252
FP 2520 GOSUB2810:PRINT"{YEL}
        {SPACE}YOU WIN!";:X=X+
        1:U=1:W=70:GOSUB2840:I
        FX<20THEN2520
KA 2530 GOSUB2810:PRINT"{GRN}P
        RESS ANY{DOWN}{7 LEFT}
        KEY";
AE 2540 POKE198,0
AG 2550 GETA$:IFA$=""THEN2550
KM 2560 RUN
GP 2570 GOSUB2810:PRINT"{YEL}
        {SPACE}GOT YOU!";:U=3:
        W=15:GOSUB2840:POKESP+
        21,2
GC 2580 IFJ<10000THENGOSUB2740
        :PRINT"{6 SPACES}
        {6 LEFT} 0";
JX 2590 FORX=1TO1500:NEXTX
AE 2600 GOTO2530
ED 2610 POKESP+3,250
GP 2620 GETA$:TM=SC-(INT(TI/60
        )-TE)
SS 2630 IFMP=1THENPRINT"{HOME}
        {23 DOWN}"TAB(28);
JE 2640 IFMP=2THENPRINT"{HOME}
        {17 DOWN}"TAB(30);
KD 2650 PRINT"TIME:"TM"{LEFT}
        {SPACE}";
HH 2660 IFTM=0THEN2760
HK 2670 IFMP=1THENPRINT"{HOME}
        {20 DOWN}"TAB(Y);
DD 2680 IFMP=2THENPRINT"{HOME}
        {DOWN}"TAB(20+Y);
QJ 2690 IFRA<4THENPRINT"{RVS}
        {SPACE}{OFF}{LEFT}";:R
        A=RA+1:GOTO2710
PC 2700 PRINT" {LEFT}";:RA=0
XB 2710 IFA$=""THEN2620
DP 2720 PRINT" {LEFT}";:GOSUB1
        100
BQ 2730 GOTO2610
AB 2740 IFMP=1THENXX=13:YY=23:
        GOSUB2450:RETURN
QA 2750 XX=33:YY=13:GOSUB2450:
        RETURN
CD 2760 IFMP=1THENXX=1:YY=22
HE 2770 IFMP=2THENXX=29:YY=20
EH 2780 GOSUB2810:PRINT"{YEL}T
        IME IS UP"
JM 2790 WX=WX+1:U=1:W=15:GOSUB
        2840:IFWX<15THEN2780
FD 2800 GOTO2530
CJ 2810 IFMP=1THENXX=1:YY=22:G
        OTO2830
AQ 2820 XX=29:YY=20
GJ 2830 GOSUB2450:PRINT"
        {10 SPACES}{DOWN}
        {10 LEFT}{10 SPACES}
        {UP}{10 LEFT}";:RETURN
MQ 2840 FORS=1TOU:POKEN+24,15:
        POKEN+6,247:POKEN+4,17
        :POKEN+1,W
SB 2850 FORQ=1TO30:NEXTQ:POKEN
        +4,16:NEXTS:RETURN
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Give 'N' Take

Article on page 25.

Program 1: Give 'N' Take

```
BE 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS INC. -
      {SPACE}ALL RIGHTS RESERV
      ED
CA 20 PRINT"{CLR}{8}CHECKING D
      ATA":FORI=0TO10:READA$:N
      EXT
MR 30 FORI=1TO772:READA:X=X+A:
      NEXT:IFX<>50410THENPRINT
      "DATA STATEMENT ERROR.":
      STOP
KP 40 SD=54272:FORI=SDTOSD+23:
      POKEI,0:NEXT:POKESD+24,1
      5
CM 50 DIMA$(18),P(70),OFF(70),
      XX(70),YY(70),NP(70),CP(
      70,7),PI(2,18),TEMP(70)
XS 60 DIMHO(70),OH(70)
PR 70 RESTORE:POKE53280,6:POKE
      53281,6:GOSUB1560:GOSUB1
      260:TX=12:TY=14:GOSUB123
      0
CA 80 PRINT"{RVS}1{OFF} OR
      {RVS}2{OFF} PLAYERS
      {HOME}":GOSUB1240:C64=C:
      IFC=2THEN110
PK 90 F2=0:TX=6:TY=16:GOSUB123
      0:PRINT"COMPUTER FIRST
      {RVS}1{OFF} OR SECOND
      {RVS}2{OFF}{HOME}"
AF 100 GOSUB1240:CP=C-1:GOTO12
       0
PE 110 TX=11:TY=16:GOSUB1230:P
       RINT"{RVS}1{OFF} OR
       {RVS}2{OFF} JOYSTICKS
       {HOME}":GOSUB1240:F2=C-
       1
BS 120 TX=6:TY=24:GOSUB1230:PR
       INT"{4 SPACES}DEFINING
       {SPACE}CHARACTERS
       {5 SPACES}{HOME}"
DQ 130 CL(0)=3:CL(1)=14:PL=0:M
       ES$(3)="{RVS}1{OFF} OR
       {SPACE}{RVS}2{OFF} JOYS
       TICKS"
AQ 140 AN=43:FORI=0TO10:READN$
       (I):NEXT:DATA " ",1,2,3
       ,4,5,6,6,8,9,10
CS 150 MES$(1)="{2 SPACES}DESI
       GNING BOARD{3 SPACES}":
       MES$(2)="{2 SPACES}DIVI
       DING PIECES"
SD 160 WI$(0)="{RVS}{8}
       {9 SPACES}PLAYER 1":WI$
       (1)="{RVS}{8}{9 SPACES}
       PLAYER 2"
HJ 170 FORI=1TO70:READNP(I):NE
       XT
JR 180 DATA 2,5,3,4,4,3,4,4,3,
       4,2,5,5,7,5,5,5,6,5,5,4
       ,5,7,6,4,6,5,4,6,4,7,5,
       5,6,5
MJ 190 DATA 4,4,4,4,5,6,6,7,6,
       6,5,3,5,4,6,5,5,6,5,6,6
       ,5,6,3,2,4,4,5,7,3,4,6,
       4,5,1
KF 200 FORI=1TO70:FORX=1TONP(I
       ):READCP(I,X):NEXTX,I
KQ 210 DATA 2,12,1,3,12,13,14,
       2,4,14,3,5,14,15,4,6,15
       ,16,5,7,16,6,8,17,18
GJ 220 DATA 7,9,10,19,8,10,19,
       8,9,11,20,10,20,1,2,13,
       21,22,12,14,2,22,23
BD 230 DATA 2,3,4,13,15,23,24,
       4,5,14,16,24,5,6,15,17,
       26,7,16,18,26,27
PA 240 DATA 7,17,19,27,28,34,8
       ,9,18,20,28,10,11,19,28
       ,36,12,22,29,37
JM 250 DATA 12,13,21,23,29,13,
       14,22,24,30,31,41,14,15
       ,23,25,26,31,24,26,31,3
       2
PC 260 DATA 25,24,17,16,27,32,
       26,17,18,33,34,18,19,20
       ,35,21,22,30,37,38,40
ED 270 DATA 23,29,40,41,23,24,
       25,32,41,42,43,25,26,31
       ,33,43
DK 280 DATA 27,32,34,43,44,18,
       27,33,35,44,45,28,34,36
       ,45,46
DR 290 DATA 20,35,46,47,21,29,
       38,48,29,37,39,48,38,40
       ,49,50,29,30,39,41,50
HG 300 DATA 23,30,31,40,42,52,
       31,41,43,52,53,54,31,32
       ,33,42,44,54,55
QB 310 DATA 33,34,43,45,55,56,
       34,35,44,46,56,58,35,36
       ,45,47,58,36,46,59,37,3
       8,49
SK 320 DATA 60,61,39,48,50,61,
       39,40,49,51,52,62,50,52
       ,53,62,63,41,42,50,51,5
       3,42
BH 330 DATA 52,51,54,63,64,42,
       43,53,55,64,43,44,54,56
       ,64,67
BK 340 DATA 44,45,55,57,58,67,
       56,58,67,68,69,45,46,56
       ,57,59,69,47,58,69
DX 350 DATA 48,61,48,49,60,62,
       50,51,61,63,51,53,62,64
       ,65
GP 360 DATA 53,54,55,63,65,66,
       67,63,64,66,64,65,67,68
       ,55,56,64,66,57,68
RM 370 DATA 66,67,57,69,57,58,
       59,68,70,69
JM 380 TY=24:TX=10:GOSUB1230:P
       RINTMES$(1)"{HOME}"
JC 390 ML$="{I}"+CHR$(8)+"{X}<
       "+CHR$(3)+"{2}XJ"+CHR$(
       16)+CHR$(248)+"L{B}{T}"
       :POKE835,0
AQ 400 POKE53272,PEEK(53272)AN
       D240OR12
EP 410 POKE836,208:POKE830,0:P
       OKE831,216:POKE828,0:PO
       KE829,56:POKE56334,0
AJ 420 POKE1,51:ML$=ML$:SYS(PE
       EK(51)+256*PEEK(52)):PO
       KE1,55:POKE56334,1
KE 430 FORI=12568TO12663:READJ
```

```
        :POKEI,J:NEXT
EP 440 DATA 0,126,126,126,126,
       126,126,126,126,126,126
       ,126,126,126,126,0
QM 450 DATA 0,254,254,254,254,
       254,254,0,0,127,127,127
       ,127,127,127,0
BM 460 DATA 126,126,126,126,12
       6,126,126,126,0,255,255
       ,255,255,255,255,0
PR 470 DATA 0,127,127,127,127,
       127,127,127,0,254,254,2
       54,254,254,254,254
BM 480 DATA 254,254,254,254,25
       4,254,254,0,127,127,127
       ,127,127,127,127,0
XX 490 DATA 127,127,127,127,12
       7,127,127,127,254,254,2
       54,254,254,254,254,254
JJ 500 A$(1)=")%{DOWN}{2 LEFT}
       $":A$(2)="&*{DOWN}
       {LEFT}$":A$(3)="#{DOWN}
       {LEFT},%":A$(4)="#
       {DOWN}{2 LEFT}&+"
RS 510 A$(5)="#{DOWN}{2 LEFT}&
       {RVS} {OFF}%{DOWN}
       {2 LEFT}$":A$(6)=")*
       {DOWN}{2 LEFT},+":A$(7)
       ="#{DOWN}{LEFT}'{DOWN}
       {LEFT}$":A$(8)="&(%"
DQ 520 A$(9)="#{DOWN}{2 LEFT}&
       {RVS}{@3}{OFF}%":A$(10)=
       "&{RVS}{T3}{OFF}%{DOWN}
       {2 LEFT}$":A$(11)="#
       {DOWN}{LEFT}-%{DOWN}
       {2 LEFT}$":A$(12)="#
       {DOWN}{2 LEFT}&.{DOWN}
       {LEFT}$"
JH 530 A$(13)=")(*{DOWN}
       {3 LEFT}${RIGHT}$":A$(1
       4)="#{DOWN}{LEFT},(+
       {LEFT}{UP}#":A$(15)=")%
       {DOWN}{2 LEFT}'{DOWN}
       {LEFT},%"
RX 540 A$(16)="&*{DOWN}{LEFT}'
       {DOWN}{2 LEFT}&+":A$(17
       )="#{DOWN}{LEFT}-*
       {DOWN}{2 LEFT},{RVS}{@3}
       {OFF}%":A$(18)="){RVS}
       {T3}{OFF}%{DOWN}{3 LEFT}
       -+{DOWN}{2 LEFT}$"
FS 550 FORI=1TO70:OFF(I)=2:NEX
       T:FORI=1TO70:READP(I):N
       EXT
XD 560 DATA 1,5,8,4,1,1,9,10,1
       ,16,7,6,4,7,8,3,2,7,3,1
       0,11,2,13,10,1,10,2,8
QX 570 DATA 6,4,17,6,7,5,10,12
       ,7,1,4,2,7,10,7,9,6,15,
       2,15,9,12,7,2,12,3,6,2,
       7
PF 580 DATA 10,4,8,2,3,14,8,3,
       2,5,9,18,4
AS 590 FORI=1TO70:READXX(I),YY
       (I):NEXT
MC 600 DATA 101,86,117,86,125,
       86,149,86,157,86,173,86
       ,189,86,197,86,213,94,2
       21,86
RS 610 DATA 237,86,101,102,125
       ,102,133,94,141,102,165
       ,94,181,102,197,102,205
       ,102
PC 620 DATA 221,110
JH 630 DATA 101,118,109,118,12
       5,118,141,110,157,118,1
       65,110
MC 640 DATA 181,118,205,118,10
       9,134,133,126,149,126,1
       65,126
AG 650 DATA 181,126,197,126,20
       5,126,237,118,101,142,1
       09,150,125,150
MD 660 DATA 125,142,141,134
RE 670 DATA 149,150,173,142.18
       9,142,205,142,221,134,2
       29,142,101,166,117,166
MM 680 DATA 133,158,141,166,14
       1,158,157,166,165,158,1
       81,158,197,158,213,166
SB 690 DATA 213,158,237,158,10
       1,190,117,182,133,182,1
       49,182,165,174,173,182
JB 700 DATA 181,182,197,166,20
       5,182,221,174,236,182
QB 710 GOSUB1230:PRINTMES$(2)"
       {HOME}"
XX 720 FORI=1TO70:TEMP(I)=1:NE
       XT:FORX=0TO1:FORZ=1TO35
SK 730 I=INT(70*RND(1))+1:IFTE
       MP(I)=0THEN730
FB 740 TEMP(I)=0:PI(X,P(I))=PI
       (X,P(I))+1:NEXTZ,X
RR 750 POKE53280,15:POKE53281,
       15:GOSUB1290
XB 760 V=53248:POKEV+21,4:POKE
       2042,13
AP 770 FORN=0TO62:READSP:POKE8
       32+N,SP:NEXT:POKEV+41,1
XA 780 DATA 0,0,0,0,0,0,0,0,0,
       0,0,0,0,0,0,0,3,192,0,7
       ,224,0,15,240,0,15,240
GE 790 DATA 0,15,240,0,7,224,0
       ,3,192,0,0,0,0,0 ,0,0,0
       ,0,0,0,0,0,0,0,0,0,0,0,
       0
RS 800 DATA 0,0,0,0,0,0,0,237
HR 810 PRINT"{HOME}{DOWN}"SPC(
       17)MES$(6):GOSUB1200:GO
       SUB1070
JB 820 IFC64=1ANDPL=CPTHEN1590
SS 830 JY=15-(PEEK(56320+PL*F2
       )AND15):FR=PEEK(56320+P
       L*F2)AND16
AG 840 IFJY=8THENAN=AN+1
SF 850 IFJY=4THENAN=AN-1
FX 860 IFAN=0THENAN=70
KF 870 IFAN=71THENAN=1
BA 880 IFFR=0THEN900
JM 890 POKEV+4,XX(AN):POKEV+5,
       YY(AN):GOTO830
DQ 900 IFOFF(AN)<>2ORPI(PL,P(A
       N))=0THENGOSUB1670:GOTO
       830
MH 910 PI(PL,P(AN))=PI(PL,P(AN
       ))-1:TU=TU+1
XQ 920 POKE646,CL(PL):OFF(AN)=
       PL:QQ=AN:GOSUB1190:SC(P
       L)=SC(PL)+1:PRINTA$(P(A
       N))
HA 930 FORI=1TONP(AN):QQ=CP(AN
       ,I):IFOFF(QQ)=2OROFF(QQ
       )=PLTHEN960
FQ 940 LP=-PL+1:GOSUB1190:SC(L
       P)=SC(LP)-1:SC(PL)=SC(P
       L)+1:PRINTA$(P(QQ))
SG 950 OFF(QQ)=PL
DF 960 NEXT:PL=-PL+1:GOSUB1690
       :GOSUB1200:IFTU=70THENG
       OSUB1070:GOTO980
DD 970 GOTO810
EP 980 GOSUB1710:TY=22:POKEV+2
       1,0:PL=1:IFSC(0)>SC(1)T
       HENPL=0
SD 990 IFGT=0THENPL=-PL+1
RH 1000 WI$(PL)=WI$(PL)+" IS T
        HE WINNER "
EJ 1010 IFSC(0)=SC(1)THENWI$(P
        L)="{8}{RVS}
        {15 SPACES}IT'S A TIE
        {7 SPACES}"
AF 1020 TX=0:GOSUB1230:PRINT"
        {8}" WI$(PL):FORI=1TO5
        0:GOSUB1050:NEXT:TX=8
XD 1030 GOSUB1230:PRINT"{RVS}P
        RESS FIRE TO PLAY AGAI
        N":FORI=1TO50:GOSUB105
        0:NEXT
JS 1040 GOTO1020
XA 1050 FR=PEEK(56320)AND16:RF
        =PEEK(56321)AND16:IFFR
        =0ORRF=0THENRUN
FC 1060 RETURN
XH 1070 PRINT"{HOME}{6 DOWN}
        {RVS}{8}{RIGHT}"N$(PI(
        0,13))"{3 RIGHT}"N$(PI
        (0,14))"{2 RIGHT}"N$(P
        I(0,7))SPC(23);
QJ 1080 PRINTN$(PI(1,13))"
        {3 RIGHT}"N$(PI(1,14))
        "{2 RIGHT}"N$(PI(1,7))
ED 1090 PRINT"{3 DOWN}{RVS}"N$
        (PI(0,16))"{2 RIGHT}"N
        $(PI(0,15))"{3 RIGHT}
        {UP}"N$(PI(0,10))SPC(2
        3)"{DOWN}";
FC 1100 PRINTN$(PI(1,16))"
        {2 RIGHT}"N$(PI(1,15))
        "{3 RIGHT}{UP}"N$(PI(1
        ,10))
RD 1110 PRINT"{3 DOWN}{RVS}"N$
        (PI(0,1))"{3 RIGHT}"N$
        (PI(0,2))"{2 RIGHT}
        {UP}"N$(PI(0,9))SPC(23
        )"{DOWN}";
CC 1120 PRINTN$(PI(1,1))"
        {3 RIGHT}"N$(PI(1,2))"
        {2 RIGHT}{UP}"N$(PI(1,
        9))
QA 1130 PRINT"{3 DOWN}{RVS}"N$
        (PI(0,3))"{2 RIGHT}"N$
        (PI(0,4))"{2 RIGHT}"N$
        (PI(0,18))SPC(24);
PF 1140 PRINTN$(PI(1,3))"
        {2 RIGHT}"N$(PI(1,4))"
        {2 RIGHT}"N$(PI(1,18))
JE 1150 PRINT"{4 DOWN}{RVS}"N$
        (PI(0,11))"{3 RIGHT}"N
        $(PI(0,12));
FG 1160 PRINT"{2 RIGHT}"N$(PI(
        0,17))"{3 RIGHT}"N$(PI
        (0,5))"{3 RIGHT}"N$(PI
        (0,8))"{UP}{2 RIGHT}"N
        $(PI(0,6));
DX 1170 PRINT"{RIGHT}"N$(PI(1,
        6))"{DOWN}{2 RIGHT}"N$
        (PI(1,8))"{3 RIGHT}"N$
        (PI(1,5))"{2 RIGHT}";
DX 1180 PRINTN$(PI(1,11))"
        {4 RIGHT}"N$(PI(1,12))
        "{2 RIGHT}"N$(PI(1,17)
        )"{HOME}":RETURN
SP 1190 TX=INT(XX(QQ)/8)-1:TY=
        INT(YY(QQ)/8)-5:GOSUB1
        230:RETURN
QK 1200 PC=1:IFPL=0THENPC=3
DE 1210 POKE646,PC:PRINT"
        {HOME}{DOWN}{RVS}
        {2 RIGHT}PLAYER 1{RVS}
        {8}{2 RIGHT}{2 SPACES}
        {3 LEFT}"SC(0):PC=1:IF
        PL=1THENPC=14
PP 1220 POKE646,PC:PRINTTAB(26
        )"{UP}{RVS}PLAYER 2
        {RVS}{8}{2 RIGHT}
        {2 SPACES}{3 LEFT}"SC(
        1)" ":RETURN
QP 1230 POKE783,0:POKE781,TY:P
        OKE782,TX:SYS65520:RET
        URN
QS 1240 POKE198,0:WAIT198,1:GE
        TC$:C=VAL(C$):IFC<1ORC
        >2THEN1240
ES 1250 RETURN
KP 1260 POKE198,0:WAIT198,1:GE
        TC$:IFC$<>"G"ANDC$<>"T
        "THEN1260
HG 1270 ME$(6)="{RVS}TAKE":GT=
        1:IFC$="G"THENME$(6)="
```

```
        {RVS}GIVE":GT=0
CA 1280 RETURN
KH 1290 PRINT"{CLR}{RVS}{8 SPACES}
        {63 SPACES}";
KS 1300 PRINT"{65 SPACES}";
HH 1310 PRINT"{CYN}{OFF}#{8 SPACES}
        {RVS}{30 SPACES}{7 SPACES}
        {OFF}#{CYN})(*{8 SPACES}{RVS}
         {CYN}{OFF}#{8 SPACES}{RVS}
        {CYN}{OFF}#{8 SPACES}{RVS}
        {CYN}{OFF}'{8 SPACES}{RVS}
        {PUR}{2 SPACES}";
EB 1320 PRINT"{18 SPACES}{8 SPACES}
        {7 SPACES}{OFF})(*{8 SPACES}{RVS}
        {7 SPACES}{OFF}#{8 SPACES}{RVS} {7 SPACES}
        {OFF}#{8 SPACES}{RVS} {7 SPACES}
        {OFF}'{CYN}${8 SPACES}{RVS}
        {CYN}{OFF}${8 SPACES}{RVS}
        {CYN}{OFF},(+{8 SPACES}{RVS}
        {SPACE}{CYN}{OFF}${8 SPACES}"
        ;
DQ 1330 PRINT"{RVS} {PUR} {5 SPACES}
        {OFF})%#&(%#)%)%#&
        {RVS}{T SPACES}{OFF}%&*#{PUR}
        {RVS} {8 SPACES} {7 SPACES}{OFF}${8 SPACES}
        {RVS} {7 SPACES}{OFF}${8 SPACES}
        {RVS} {7 SPACES}{OFF},(+{8 SPACES}
        {RVS} {7 SPACES}{OFF}${RVS}
        {8 SPACES}{10 SPACES}";
XP 1340 PRINT"{PUR} {5 SPACES}{OFF}$&
        {RVS} {OFF}%#&+$#$&
        {RVS}{@ SPACES}{OFF}%$)%''
        {PUR}{RVS} {8 SPACES}
        {20 SPACES}{PUR} {5 SPACES}
        {OFF})*$#'&(%,%&*";
JB 1350 PRINT"##$&+${PUR}{RVS}
         {8 SPACES}{10 SPACES}{CYN}
        {OFF}&*{8 SPACES}{RVS} {CYN}
        {OFF})%{8 SPACES}{RVS} {CYN}
        {OFF}&{RVS}{T SPACES}{OFF}%
        {8 SPACES}{RVS} {PUR} {5 SPACES}
        {OFF},+&+$&{RVS}{T SPACES}
        {OFF}%&{RVS}{T SPACES}{OFF}%$
        ',";
SJ 1360 PRINT"%&{RVS}{T SPACES}{OFF}%
        {PUR}{RVS} {8 SPACES} {7 SPACES}
        {OFF}&*{8 SPACES}{RVS} {7 SPACES}
        {OFF})%{8 SPACES}{RVS} {7 SPACES}
        {OFF}&{RVS}{T SPACES}{OFF}%
        {8 SPACES}{RVS} {CYN}{OFF}'
        {8 SPACES}{RVS} {CYN}{OFF}'
        {8 SPACES}{RVS} ";
BJ 1370 PRINT"{2 SPACES}{CYN}
        {OFF}${8 SPACES}{RVS}
        {2 SPACES}{PUR} {5 SPACES}
        {OFF}#&*)(*$)%$&*$&(%$
        #{PUR}{RVS} {8 SPACES}
        {2 SPACES}{7 SPACES}{OFF}'{8 SPACES}
        {RVS} {7 SPACES}{OFF}'{8 SPACES}
        {RVS}{3 SPACES}{7 SPACES}
        {OFF}${8 SPACES}{RVS} {CYN}
        {OFF}&+{8 SPACES}{RVS} {CYN}
        {OFF}";
MR 1380 PRINT",%{8 SPACES}{RVS}
        {5 SPACES}{PUR} {5 SPACES}
        {OFF}-%$$#$#$)*#$#&
        {RVS}{T SPACES}{OFF}%&.{PUR}
        {RVS} {8 SPACES} {7 SPACES}{OFF}&+
        {8 SPACES}{RVS} {7 SPACES}{OFF},%{8 SPACES}
        {RVS}{4 SPACES}";
JR 1390 PRINT"{10 SPACES}{PUR}
         {5 SPACES}{OFF}$)*&+#-*,+'&
        {RVS} {OFF}%";
MM 1400 PRINT"$)%${PUR}{RVS}
        {8 SPACES}{17 SPACES}{CYN}
        {OFF}#{8 SPACES}{RVS}
        {2 SPACES}{PUR} {5 SPACES}
        {OFF}#,+&*',{RVS}{@ SPACES}
        {OFF}%#$#$)*'&*{PUR}
        {RVS} {8 SPACES}{5 SPACES}";
BQ 1410 PRINT"{3 SPACES}{7 SPACES}
        {OFF}#{8 SPACES}{RVS} {CYN}
        {OFF})%{8 SPACES}{RVS} {CYN}
        {OFF}&*{8 SPACES}{RVS} {CYN}
        {OFF}&{RVS}{@ SPACES}{OFF}%
        {8 SPACES}{RVS} {PUR} {5 SPACES}
        {OFF}')%#$$&{RVS}
        {OFF}%";
HD 1420 PRINT"'&{RVS}{@ SPACES}{OFF}%
        ,+,%${PUR}{RVS} {8 SPACES}
        {7 SPACES}{OFF})%{8 SPACES}{RVS} {7 SPACES}
        {OFF}&*{8 SPACES}{RVS} {7 SPACES}
        {OFF}&{RVS}{@ SPACES}{OFF}%
        {CYN}${8 SPACES}{RVS}
        {3 SPACES}{CYN}{OFF}$"
        ;
SG 1430 PRINT"{8 SPACES}{RVS}
        {5 SPACES}{PUR} {5 SPACES}
        {OFF}$$&+#&*$#$)*&*&
        {RVS}{T SPACES}{OFF}%#{PUR}
        {RVS} {8 SPACES} {7 SPACES}{OFF}${8 SPACES}
        {RVS}{3 SPACES}{7 SPACES}
        {OFF}${8 SPACES}{RVS}
        {14 SPACES}{PUR} {5 SPACES}";
EX 1440 PRINT"{OFF})%#&.#$#,%,
        +#$#$&+{PUR}{RVS} {8 SPACES}
        {16 SPACES}{CYN}{OFF})
        {RVS}{T SPACES}{OFF}%{8 SPACES}{RVS}
         {PUR} {5 SPACES}{OFF}'&{RVS}
        {@ SPACES}{OFF}%$'&.&(%";
AR 1450 PRINT"&{RVS} {OFF}%')
        {RVS}{T SPACES}{OFF}%{PUR}
        {RVS} {8 SPACES}{7 SPACES}{7 SPACES}
        {OFF}){RVS}{T SPACES}{OFF}%
        {CYN}#{8 SPACES}{RVS}
        {3 SPACES}{CYN}{OFF}#
        {8 SPACES}{RVS} {CYN}{OFF}-+
        {8 SPACES}{RVS}{2 SPACES}";
PK 1460 PRINT"{PUR} {5 SPACES}{OFF},%
        &*#$#$###&*$#$-+#{PUR}
        {RVS} {8 SPACES} {7 SPACES}{OFF}#{8 SPACES}
        {RVS}{3 SPACES}";
MK 1470 PRINT"{7 SPACES}{OFF}#{8 SPACES}
        {RVS} {7 SPACES}{OFF}-+{8 SPACES}
        {RVS} {CYN}{OFF},%{8 SPACES}
        {RVS} {CYN}{OFF}&+{8 SPACES}
        {RVS} {CYN}{OFF}${8 SPACES}
        {RVS}{3 SPACES}{PUR}
        {5 SPACES}{OFF}&(%$,%,(+";
EG 1480 PRINT",%$&{RVS}{@ SPACES}
        {OFF}%$&+{PUR}{RVS}
        {8 SPACES} {7 SPACES}{OFF},%{8 SPACES}{RVS}
         {7 SPACES}{OFF}&+{8 SPACES}{RVS}
        {7 SPACES}{OFF}${8 SPACES}{RVS}
        {7 SPACES}";
EB 1490 PRINT"{5 SPACES}{PUR}
        {20 SPACES}{8 SPACES}
        {39 SPACES}";
XC 1500 PRINT"{11 SPACES}{CYN}
        {OFF}#{8 SPACES}{RVS}
        {3 SPACES}{CYN}{OFF}#
        {8 SPACES}{RVS} {CYN}{OFF}#
        {8 SPACES}{RVS}{4 SPACES}
        {CYN}{OFF}#{8 SPACES}{RVS}
        {5 SPACES}{CYN}{OFF})*
        {8 SPACES}{RVS} {7 SPACES}{OFF})*{8 SPACES}
        {RVS}{3 SPACES}";
RG 1510 PRINT"{2 SPACES}{7 SPACES}
        {OFF}#{8 SPACES}{RVS}
        {2 SPACES}{7 SPACES}{OFF}#{8 SPACES}
        {RVS}{4 SPACES}{7 SPACES}
        {OFF}#{8 SPACES}{RVS} {7 SPACES}
        {OFF}#{8 SPACES}{RVS}
        {2 SPACES}{CYN}{OFF}-%
        {8 SPACES}{RVS} {CYN}{OFF}&.
        {8 SPACES}{RVS} {CYN}{OFF}-*
        {8 SPACES}{RVS}{2 SPACES}";
BB 1520 PRINT"{CYN}{OFF}&{RVS}
         {OFF}%{8 SPACES}{RVS}
        {4 SPACES}{CYN}{OFF},+
        {8 SPACES}{RVS} {7 SPACES}{OFF},+{8 SPACES}
        {RVS}{4 SPACES}{7 SPACES}
        {OFF}&{RVS} {OFF}%{8 SPACES}
        {RVS} {7 SPACES}{OFF}-%{8 SPACES}
        {RVS}{2 SPACES}{7 SPACES}
        {OFF}&";
XP 1530 PRINT".{8 SPACES}{RVS} {7 SPACES}
        {OFF}-*{8 SPACES}{RVS} {CYN}
        {OFF}${8 SPACES}{RVS}
        {3 SPACES}{CYN}{OFF}$
        {8 SPACES}{RVS} {CYN}{OFF},
        {RVS}{@ SPACES}{OFF}%{8 SPACES}{RVS}
        {2 SPACES}{CYN}{OFF}$
        {8 SPACES}{RVS}{2 SPACES}
        {CYN}{OFF}&(%{8 SPACES}{RVS}
        {3 SPACES}";
SC 1540 PRINT"{2 SPACES}{7 SPACES}
        {OFF}&(%{8 SPACES}{RVS}
        {2 SPACES}{7 SPACES}{OFF}${8 SPACES}
        {RVS}{2 SPACES}{7 SPACES}
        {OFF}${8 SPACES}{RVS}
        {4 SPACES}{7 SPACES}{OFF}${8 SPACES}
        {RVS} {7 SPACES}{OFF},{RVS}
        {@ SPACES}{OFF}%{8 SPACES}{RVS}
        {24 SPACES}";
SK 1550 PRINT"{15 SPACES}
        {HOME}":POKE2023,160:P
        OKE56295,15:POKE53281,
        0:RETURN
DF 1560 PRINT"{CLR}{2 SPACES}C
        OPYRIGHT 1987 COMPUTE!
         PUBLICATIONS"
SJ 1570 PRINTTAB(9)"ALL RIGHTS
         RESERVED"
DG 1580 TY=12:TX=13:GOSUB1230:
        PRINT"{RVS}G{OFF}IVE O
        R {RVS}T{OFF}AKE{HOME}
        ":RETURN
GS 1590 MT=0:FORI=1TO70:HO(I)=
        0:NEXT:FORI=1TO70
KG 1600 IFOFF(I)<>2ORPI(PL,P(I
        ))=0THEN1620
HK 1610 HO(I)=1:MT=MT+1
DG 1620 NEXT
CE 1630 MV=0:FORZ=1TO70:IFHO(Z
        )=1THENMV=MV+1:OH(MV)=
        Z
RK 1640 NEXT
JS 1650 NA=INT(MT*RND(1))+1:AN
        =OH(NA):IFOFF(AN)<>2OR
        PI(PL,P(AN))=0THEN1650
EE 1660 POKEV+4,XX(AN):POKEV+5
        ,YY(AN):GOTO910
XK 1670 POKESD+5,31:POKESD+6,2
        08:POKESD,240:POKESD+1
        ,4:POKESD+4,33
HQ 1680 FORS=1TO100:NEXT:GOTO1
        700
XQ 1690 POKESD+5,8:POKESD+6,24
        0:POKESD,0:POKESD+1,90
        :POKESD+4,17
CX 1700 FORS=1TO100:NEXT:POKES
        D+4,0:POKESD,0:POKESD+
        1,0:RETURN
PQ 1710 PRINT"{HOME}{3 DOWN}
        {RVS}{8 SPACES}{40 SPACES}";:
        FORI=1TO16
AB 1720 PRINT"{RVS}{9 SPACES}"
        SPC(22)"{9 SPACES}";:N
        EXT
QF 1730 FORI=1TO4:PRINT"{RVS}
        {40 SPACES}";:NEXT
PP 1740 PRINT"{RVS}{39 SPACES}
        {HOME}{DOWN}{2 RIGHT}
        {8 SPACES}PLAYER 1{BLK}":RETU
        RN
```

Program 2: Give 'N' Take Loader

```
CB 10 PRINT"{CLR}{3 DOWN}POKE4
      4,64:POKE16384,0:NEW"
PF 20 PRINT"{2 DOWN}LOAD"CHR$(
      34)"GIVE 'N' TAKE"CHR$(3
      4)",8"
KQ 30 PRINT"{4 DOWN}RUN"
PK 40 PRINT"{HOME}"
KC 50 POKE198,3:POKE631,13:POK
      E632,13:POKE633,13
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Multisprite

See instructions in article on page 55 before typing in.

Program 1: Multisprite

```
8000:A9 0C 8D 20 D0 A9 0B 8D 5D
8008:21 D0 A9 0D 8D 86 02 A2 01
8010:00 BD 1F 80 F0 06 20 D2 1F
8018:FF E8 D0 F5 4C B0 80 93 86
8020:20 20 20 20 20 20 20 12 13
8028:20 20 20 20 20 20 20 4D 56
8030:55 4C 54 49 53 50 52 49 D7
8038:54 45 20 20 20 20 20 20 9C
8040:20 20 92 0D 0D 20 20 20 C5
8048:43 4F 50 59 52 49 47 48 EC
8050:54 20 31 39 38 37 20 43 5F
8058:4F 4D 50 55 54 45 21 20 CD
8060:50 55 42 2E 2C 20 49 4E CC
8068:43 2E 0D 20 20 20 20 20 1C
8070:20 20 20 20 20 41 4C 4C 7A
8078:20 52 49 47 48 54 53 20 16
8080:52 45 53 45 52 56 45 44 75
8088:2E 0D 11 11 11 11 11 0D 13
8090:20 20 20 20 20 20 20 20 91
8098:20 50 52 45 53 53 20 41 C5
80A0:4E 59 20 4B 45 59 20 54 FB
80A8:4F 20 42 45 47 49 4E 00 F1
80B0:20 E4 FF F0 FB A9 C2 8D A3
80B8:9E C3 A9 80 8D 9F C3 4C F5
80C0:00 C0 AD 6C 84 F0 08 A9 10
80C8:00 8D 6C 84 20 12 83 20 73
80D0:E4 FF D0 01 60 C9 5C F0 42
80D8:4E C9 2B F0 28 C9 2D F0 9B
80E0:24 C9 87 D0 06 A9 87 8D D7
80E8:6D 84 60 C9 8B D0 08 A9 C3
80F0:00 8D 6D 84 A9 8B 60 C9 51
80F8:31 90 09 C9 35 B0 05 8D 78
8100:6E 84 48 68 60 48 AE 6A D6
8108:84 D0 02 68 60 AE F8 07 FE
8110:C9 2B D0 06 E0 FF D0 0A EF
8118:F0 04 E0 24 D0 04 68 4C A6
8120:CF 80 20 72 82 68 60 A9 76
8128:07 8D 21 D0 AD 6A 84 D0 34
8130:03 20 CB 83 AD F8 07 CD 9B
8138:62 84 F0 06 20 B5 83 4C 37
8140:4B 81 20 E4 FF F0 FB C9 21
8148:0D D0 08 A9 0C 8D 21 D0 4B
8150:A9 00 60 20 59 81 4C 42 E1
8158:81 C9 93 D0 03 4C 7A 81 CD
8160:C9 30 90 07 C9 38 B0 03 6A
8168:4C 8F 81 C9 59 D0 03 4C A2
8170:89 83 C9 58 F0 01 60 4C 70
8178:9F 83 A9 01 8D 15 D0 A2 76
8180:00 8A 9D 41 84 E8 E0 32 A9
8188:D0 F8 68 68 4C 4B 81 A2 FA
8190:04 8E 21 D0 38 E9 30 8D C1
8198:63 84 8D 69 84 F0 1D CD A6
81A0:65 84 F0 05 90 03 8D 65 F6
81A8:84 AA 48 A9 01 0A CA D0 D2
81B0:FC 0D 15 D0 8D 15 D0 68 EF
81B8:0A 8D 69 84 20 E4 FF F0 1F
81C0:FB C9 0D F0 76 C9 91 D0 B3
81C8:0A AE 69 84 E8 DE 00 D0 85
81D0:4C BC 81 C9 11 D0 0A AE 84
81D8:69 84 E8 FE 00 D0 4C BC 57
81E0:81 C9 9D D0 31 AE 69 84 73
81E8:BD 00 D0 D0 23 AD 63 84 0D
81F0:D0 0E A9 FE 2D 10 D0 8D DD
81F8:10 D0 DE 00 D0 4C BC 81 C6
8200:AE 63 84 A9 01 0A CA D0 F6
8208:FC 49 FF AE 69 84 D0 E4 AC
8210:DE 00 D0 4C BC 81 C9 1D FF
8218:D0 F9 AE 69 84 FE 00 D0 61
8220:D0 F1 A9 01 AE 63 84 D0 2C
8228:09 0D 10 D0 8D 10 D0 4C 9E
8230:BC 81 0A CA D0 FC AE 69 23
8238:84 D0 EE AE 63 84 BC 39 5C
8240:84 8A 0A AA BD 00 D0 99 3F
8248:41 84 E8 C8 BD 00 D0 99 E1
8250:41 84 AD 63 84 D0 12 A9 38
8258:01 2D 10 D0 C8 99 41 84 EB
8260:A9 07 8D 21 D0 20 2E 84 A7
8268:60 AA A9 01 0A CA D0 FC A7
8270:F0 E7 48 AE 64 84 30 10 81
8278:E0 08 B0 0C AD 27 D0 BC 2F
8280:39 84 C8 C8 C8 99 41 84 9C
8288:68 C9 2B D0 09 8D 66 84 76
8290:EE 64 84 4C 9E 82 CE 64 7C
8298:84 A9 00 8D 66 84 AD 64 28
82A0:84 C9 00 B0 01 60 CD 65 EF
82A8:84 F0 03 90 01 60 EE 6C 69
82B0:84 AE 64 84 BC 39 84 B9 06
82B8:41 84 8D 00 D0 C8 B9 41 8F
82C0:84 8D 01 D0 AD 66 84 D0 79
82C8:03 4C EB 82 AE 64 84 D0 E8
82D0:01 60 DE F8 07 8A CA BC 8E
82D8:39 84 0A AA B9 41 84 9D 01
82E0:00 D0 C8 E8 B9 41 84 9D 3B
82E8:00 D0 60 AE 64 84 EC 65 8D
82F0:84 90 01 60 E8 8A 18 6D 91
82F8:62 84 9D F8 07 8A BC 39 A8
8300:84 0A AA B9 41 84 9D 00 14
8308:D0 C8 E8 B9 41 84 9D 00 B9
8310:D0 60 A9 00 8D 10 D0 8D A8
8318:6B 84 AE 6B 84 BD F8 07 96
8320:38 ED 62 84 AA BC 39 84 92
8328:C8 C8 B9 41 84 AE 6B 5F
8330:84 E0 00 D0 05 29 0F 8D 37
8338:05 C0 9D 27 D0 88 B9 41 75
8340:84 F0 1B E0 00 D0 0B A9 3A
8348:01 0D 10 D0 8D 10 D0 4C BC
8350:5E 83 A9 01 0A CA D0 FC C6
8358:0D 10 D0 8D 10 D0 AD 6B 67
8360:84 CD 65 84 F0 05 EE 6B F6
8368:84 D0 AF AD 6D 84 F0 13 29
8370:A9 FF 8D 1C D0 AD 6E 84 5E
8378:C9 33 D0 06 AD 27 D0 8D E4
8380:20 D0 60 A9 00 8D 1C D0 B1
8388:60 AD 67 84 49 28 8D 67 CD
8390:84 F0 06 A9 FF 8D 17 D0 A6
8398:60 A9 00 8D 17 D0 60 AD 7D
83A0:68 84 49 28 8D 68 84 F0 B0
83A8:06 A9 FF 8D 1D D0 60 A9 8C
83B0:00 8D 1D D0 60 AD 21 D0 98
83B8:A2 02 8E 21 D0 A2 00 A0 27
83C0:00 C8 D0 FD E8 D0 FA 8D 02
83C8:21 D0 60 A9 00 8D 10 D0 62
83D0:A2 00 A9 E6 9D 00 D0 E8 44
83D8:E8 E0 10 90 F7 A2 00 A9 8B
83E0:3E 9D 01 D0 18 69 15 E8 15
83E8:E8 E0 10 D0 F4 8E 6A 84 E6
83F0:AD F8 07 8D 62 84 A2 01 32
83F8:18 69 01 9D F8 07 E8 E0 F6
8400:08 D0 F5 A2 00 8A 9D 41 D0
8408:84 E8 E0 20 D0 F8 A2 00 5B
8410:A9 01 9D 27 D0 E8 E0 08 48
8418:D0 F8 A2 00 BC 39 84 C8 B8
8420:C8 C8 99 41 84 E8 E0 08 98
8428:D0 F2 20 3B 82 60 A2 DC C5
8430:A0 00 C8 D0 FD E8 D0 FA DF
8438:60 00 04 08 0C 10 14 18 53
8440:1C 00 00 00 00 00 00 00 57
8448:00 00 00 00 00 00 00 00 51
8450:00 00 00 00 00 00 00 00 59
8458:00 00 00 00 00 00 00 00 61
8460:00 00 00 00 00 00 00 00 69
8468:00 00 00 00 00 00 00 00 71
```

Program 2: Multisprite Boot Program

```
QH 10 PRINT"{CLR}{WHT}{DOWN}LO
      ADING MULTISPRITE..."
SX 20 IFA=0THENA=1:LOAD"MULTIS
      PRITE",8,1
BH 30 PRINT"{DOWN}LOADING SPRI
      TE MAGIC..."
GQ 40 IFA=1THENA=2:LOAD"SPRITE
      MAGIC",8,1
FC 50 PRINT"{2 DOWN}SYS32768
      {3 UP}"
DB 60 POKE631,13:POKE198,1:NEW
```

Exploring The SID Chip

Article on page 22.

Complex Sound

```
BE 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS INC. -
      {SPACE}ALL RIGHTS RESERV
      ED
SS 20 ADR=49152:CHK=0:C=0
GM 30 READ BYT:IF BYT=999 THEN
      60
AR 40 POKE ADR,BYT:C=C+1:ADR=A
      DR+1
EQ 50 CHK=C+BYT+CHK:GOTO30
KP 60 IF CHK<>12604 THEN100
FX 70 SYS 49152
FF 80 FOR J=1 TO 5000:NEXT
GJ 90 POKE 54276,0:POKE 54283,
      0:POKE 54290,0:END
FJ 100 PRINT"{CLR}ERROR IN DAT
      A STATEMENTS. CHECK TYP
      ING."
PH 110 DATA 162,024,169,000,15
      7,000
DH 120 DATA 212,202,016,250,16
      2,024
RJ 130 DATA 189,064,192,157,00
      0,212
RK 140 DATA 202,016,247,120,16
      9,038
SF 150 DATA 141,020,003,169,19
      2,141
DJ 160 DATA 021,003,088,169,00
      0,133
AA 170 DATA 003,096,165,003,05
      6,233
XQ 180 DATA 029,133,003,141,00
      1,212
KG 190 DATA 173,028,212,141,02
      2,212
DA 200 DATA 074,074,074,074,14
      1,015
FM 210 DATA 212,076,049,234,00
      0,000
MJ 220 DATA 000,000,129,013,00
      0,001
RQ 230 DATA 036,000,000,021,01
      3,000
XP 240 DATA 000,004,000,007,06
      5,012
HP 250 DATA 000,000,000,247,06
      3,065
CH 260 DATA 012,000,000,000,24
      7,063
PF 270 DATA 999
```

80-Column Sector Editor

Article on page 57.

Program 1: Sector Editor Boot Program

```
CA 1000 REM"{3 SPACES}LOADER F
        OR SECTOR-128
CC 1010 REM
AC 1020 GRAPHIC5
MH 1030 A$="RUN"+CHR$(13)
```

```
CG 1040 WINDOW0,0,79,24,1
EG 1050 PRINTCHR$(147);CHR$(28
        );CHR$(14);"LOADING SE
        CTOR-128, PLEASE WAIT.
        .."
PQ 1060 POKE46,34:POKE8704,0
RA 1070 DLOAD"SECTOR.BAS",U(PE
        EK(186))
HK 1080 FORA=1TOLEN(A$)
XR 1090 POKE841+A,ASC(MID$(A$,
        A,1))
EP 1100 NEXTA
DM 1110 POKE208,LEN(A$)
FQ 1120 NEW
```

Program 2: Sector Editor—BASIC

```
BQ 10 REM"COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
KR 20 TRAP 4720
JB 30 FAST
KC 40 IFPEEK(46)<>34 THEN BEGI
      N
HQ 50 PRINTCHR$(14);"BASIC TOO
       LOW! -- USE THE 'SECTOR
      ' PROGRAM AS A BOOT!"
KC 60 END
AR 70 BEND
AM 80 IFPEEK(186)<8ORPEEK(186)
      >11THENPOKE186,8
JA 90 IFPEEK(7424)<>76ORPEEK(7
      494)<>32THENBLOAD"SECTOR
      .ML",D0,U(PEEK(186))
JQ 100 RD256=DEC("1D00"):WT256
       =DEC("1D09")
EB 110 DEF FN SC(X)=16+(1ANDX-
       (35ANDX>35)<31)+(1ANDX-
       (35ANDX>35)<25)+(2ANDX-
       (35ANDX>35)<18)
HE 120 DEF FN T(X)=35+(35ANDX=
       2)
FD 130 DIM KP(18)
AF 140 FORA=1TO18:READ KP(A):N
       EXTA
HQ 150 FORA=4096TO4105:POKEA,0
       :NEXTA
MB 160 ESC$=CHR$(27):CL$=CHR$(
       147):CH$=CHR$(19):GR$=C
       HR$(30):RD$=CHR$(28)
RE 170 BL$=CHR$(31):UL$=CHR$(2
       ):UO$=CHR$(130):PK$=CHR
       $(150):LG$="{8}":MG$="
       {5}"
QS 180 YL$="{YEL}":PP$="{1}":L
       B$="{7}":UC$=CHR$(142):
       LC$=CHR$(14)
QJ 190 HX$="0123456789ABCDEF"
QG 200 WINDOW0,0,79,24,0
BE 210 PRINTESC$"N";CL$;ESC$"L
       ";CHR$(11);CHR$(14);
BC 220 COLOR6,1:COLOR5,3
MK 230 TR=18:SE=0:DEV=PEEK(186
       ):DRV=0:X=0:Y=0:NS=1:NM
       =0
XG 240 PRINTGR$;UL$;"SECTOR ED
       ITOR COPYRIGHT 1987 COM
       PUTE! PUBLICATIONS, INC
       .";
FJ 250 PRINT" - ALL RIGHTS RES
       ERVED";UO$;
XE 260 GOSUB3410
QM 270 GOSUB3580
QE 280 GOSUB3300
FX 290 DO
DD 300 GOSUB4570:IFDF=0THEN BE
       GIN
MC 310 GOSUB3910:IFDF=0THEN BE
       GIN
JG 320 GOSUB4200
CJ 330 GOSUB4300
JK 340 BEND
EK 350 BEND
SP 360 LOOPUNTILDF=0
PD 370 DO
KC 380 SYSDEC("1D0F"),X,Y:X=PE
       EK(7579):Y=PEEK(7580):K
       =PEEK(213)
EE 390 L=1
ME 400 DO
ME 410 IFK=KP(L)THENEXIT
DM 420 L=L+1
KP 430 LOOPUNTILL=19
MC 440 ONLGOSUB630,630,760,760
       ,890,1050,1110,1260,405
       0,570,1700,1810,1390,15
       40,2300,2180,2610,480
DD 450 LOOP UNTILL=18ANDOK=1
KC 460 END
RJ 470 REM END OF SECTOR
GG 480 GOSUB2920
KB 490 IF OK=1 THEN BEGIN
MM 500 WINDOW0,0,79,24,1
RD 510 PRINTRD$;"BASIC V7.0"
GC 520 POKE208,0
HE 530 BEND
QJ 540 RETURN
KD 550 :
QB 560 REM SWAP MENUS
AB 570 MN=1-(MN)
XF 580 ONMN+1GOSUB3410,3500
XS 590 WINDOW0,18,79,22
HP 600 RETURN
GH 610 :
CA 620 REM NEXT BLOCK
DH 630 T1=TR:S1=SE
EK 640 SE=SE+1
QB 650 IFSE>FNSC(TR)THENBEGIN
AC 660 SE=0
DG 670 TR=TR+1
EP 680 IFTR>FNT(NS)THENBEGIN
AK 690 TR=1
RX 700 BEND
MA 710 BEND
DP 720 GOSUB2990
BF 730 RETURN
XX 740 :
AH 750 REM LAST BLOCK
JS 760 T1=TR:S1=SE
GC 770 SE=SE-1
MB 780 IFSE<0THENBEGIN
DB 790 TR=TR-1
EM 800 IFTR=0THENBEGIN
HQ 810 TR=FNT(NS)
PH 820 BEND
QG 830 SE=FNSC(TR)
DJ 840 BEND
KD 850 GOSUB2990
MR 860 RETURN
BJ 870 :
QF 880 REM NEW BLOCK
AG 890 T1=TR:S1=SE
XE 900 DO
QC 910 ML=2:PR$="NEW TRACK (1-
       "+MID$(STR$(FNT(NS)),2)
       +") :"
HQ 920 GOSUB3060:IFIP$=ESC$THE
       NTR=T1:ELSE TR=INT(VAL(
       IP$))
PE 930 LOOPUNTILTR>0ANDTR=<FNT
       (NS)
XH 940 DO
RF 950 ML=2:PR$="NEW SECTOR (0
       -"+MID$(STR$(FNSC(TR)),
       2)+") :"
BS 960 GOSUB3060:IFIP$=ESC$THE
       NBEGIN
JK 970 SE=S1:TR=T1
CX 980 BEND:ELSE SE=INT(VAL(IP
       $))
KD 990 LOOPUNTILSE>=0ANDSE<=FN
       SC(TR)
KS 1000 GOSUB580
QQ 1010 GOSUB2990
SS 1020 RETURN
FB 1030 :
DR 1040 REM LINK SECTOR
DX 1050 T1=TR:S1=SE
AX 1060 TR=LT:SE=LS
KD 1070 GOSUB2990
XF 1080 RETURN
HG 1090 :
CD 1100 REM ENTER HEX
DG 1110 DO
SH 1120 DO
DX 1130 ML=2:PR$="NEW HEX VALU
        E :":GOSUB3060:IF IP$=
        ESC$ THEN IP$="FFFF"
MP 1140 H1$=LEFT$(IP$,1):H2$=M
        ID$(IP$,2)
MQ 1150 LOOPUNTILIP$="FFFF"OR(
        INSTR(HX$,H1$)*INSTR(H
        X$,H2$)<>0)
MD 1160 LOOPUNTILIP$="FFFF"OR(
        DEC(IP$)>=0ANDDEC(IP$)
        <=255)
ER 1170 IFIP$<>"FFFF"THENBEGIN
MK 1180 POKE7168+X+16*Y,DEC(IP
        $)
SE 1190 X=X+1:IFX=16THENX=0:Y=
        Y+1:IFY=16THENY=0
CP 1200 BEND
XQ 1210 GOSUB580
AX 1220 GOSUB3000
CQ 1230 RETURN
QS 1240 :
FP 1250 REM ENTER TEXT
AJ 1260 IL=0:ML=148:PR$="NEW T
        EXT :":GOSUB3060:IFIP$
        =ESC$THENIP$=""
SD 1270 GOSUB580
XR 1280 IFLEN(IP$)<>0THENBEGIN
FJ 1290 FORZ=1TOLEN(IP$)
KX 1300 PC=ASC(MID$(IP$,Z,1))
RM 1310 POKE7168+X+16*Y,PC
SR 1320 X=X+1:IFX=16THENX=0:Y=
        Y+1:IFY=16THENY=0
MG 1330 NEXTZ
HF 1340 BEND
QG 1350 GOSUB3000
GH 1360 RETURN
AH 1370 :
CG 1380 REM NEW DRIVE NO
DB 1390 T1=TR:S1=SE
FJ 1400 DO
SG 1410 ML=1:PR$="NEW DRIVE (0
        /1) :":GOSUB3060
ED 1420 LOOPUNTILIP$="0"ORIP$=
        "1"ORIP$=ESC$
PF 1430 IFIP$<>ESC$THENBEGIN
AX 1440 PRINTIP$:DRV=ASC(IP$)-
        48
AQ 1450 GOSUB580
FG 1460 GOSUB4570
SH 1470 GOSUB3910
JD 1480 GOSUB4200
AC 1490 GOSUB4300
DR 1500 BEND:ELSE GOSUB580
PX 1510 RETURN
MA 1520 :
GD 1530 REM NEW DEVICE NO
GM 1540 OD=DEV
RD 1550 DO
QQ 1560 ML=2:PR$="NEW DEVICE (
        8-11) :":GOSUB3060
CQ 1570 LOOPUNTIL(VAL(IP$)>7AN
        DVAL(IP$)<12)ORIP$=ESC
        $
CS 1580 IFIP$<>ESC$THENBEGIN
DQ 1590 DEV=VAL(IP$)
BC 1600 OPEN1,DEV,1:CLOSE1:IFS
        T<>0THENDEV=OD
KG 1610 GOSUB580
MA 1620 GOSUB4570
GS 1630 GOSUB3910
AM 1640 GOSUB4200
JQ 1650 GOSUB4300
```

```
GA 1660 BEND:ELSEGOSUB580
EP 1670 RETURN
SP 1680 :
GS 1690 REM SEND DISK COMMAND
CH 1700 ML=58:PR$="DISK COMMAN
        D:":GOSUB3060
CH 1710 IFIP$<>ESC$THENBEGIN
DG 1720 OPEN15,DEV,15,IP$
BG 1730 GOSUB3750
MC 1740 CLOSE15
AB 1750 GOSUB580
QX 1760 GOSUB2990
PX 1770 BEND:ELSEGOSUB580
CA 1780 RETURN
AC 1790 :
KA 1800 REM DISPLAY DISK CATAL
        OG
BM 1810 PRINTESC$"M";
HC 1820 POKE208,0
XP 1830 WINDOW0,1,79,24,1
EP 1840 PRINTRD$;"DIRECTORY:";
FC 1850 SYSDEC("1D12"),DEVAND3
        +(DRV*4)
XG 1860 SYSDEC("1D15")
RS 1870 WINDOW0,3,79,24,1
CE 1880 CT=0:TC=1
QJ 1890 DO WHILE ST<>64
KF 1900 PRINTTAB(40-(40ANDCT<2
        2));RD$;RIGHT$("00"+MI
        D$(STR$(TC),2),3);" ";
RC 1910 PRINTBL$;:SYSDEC("1D15
        ")
AS 1920 CT=CT+1:TC=TC+1
PR 1930 IFCT=44THENBEGIN
MQ 1940 WINDOW43,1,79,1,1
DA 1950 PRINTRD$;"PRESS ANY KE
        Y TO CONTINUE, Q TO QU
        IT."
XM 1960 GETKEYA$
DF 1970 PRINTCL$;BL$
BH 1980 WINDOW0,3,79,24,1
GF 1990 CT=0
QQ 2000 BEND
KB 2010 IFST=64THENBEGIN
AF 2020 PRINT"{4 LEFT}
        {4 SPACES}"
BA 2030 WINDOW43,1,79,1,1
SK 2040 PRINTRD$;"PRESS ANY KE
        Y TO CONTINUE."
BS 2050 GETKEYA$
RG 2060 PRINTCL$
HP 2070 WINDOW0,3,79,24,1
FF 2080 BEND
MQ 2090 IFA$="Q"THENEXIT
FA 2100 LOOP
QJ 2110 CLOSE8
PJ 2120 PRINTESC$"L";
DJ 2130 GOSUB3410:GOSUB3580:GO
        SUB3300
PK 2140 GOSUB3000
PG 2150 RETURN
DJ 2160 :
DS 2170 REM EXCHANGE DISKS
FP 2180 POKE208,0
JG 2190 WINDOW0,23,79,24,1
AS 2200 PRINT"INSERT NEW DISK,
         PRESS ANY WHEN DONE..
        ."
SJ 2210 GETKEYA$
FR 2220 GOSUB580
AF 2230 GOSUB3910
CB 2240 GOSUB4200
AK 2250 GOSUB4570
XC 2260 GOSUB4300
PS 2270 RETURN
EA 2280 :
PC 2290 REM FORMAT DISKS
QB 2300 DO
GE 2310 ML=1:PR$="SINGLE OR DO
        UBLE SIDED (S/D) :":GO
        SUB3060
RS 2320 LOOPUNTILIP$="S"ORIP$=
        "D"ORIP$=ESC$
KQ 2330 IFIP$<>ESC$THENBEGIN
HS 2340 IFIP$="S"THENCM$="0":E
        LSE CM$="1"
CP 2350 OPEN15,DEV,15,"U0>M"+C
        M$
PS 2360 GOSUB3750
QM 2370 CLOSE15
RD 2380 IFDF=0THENBEGIN
SF 2390 ML=16:PR$="DISK NAME :
        ":GOSUB3060
GK 2400 IFIP$<>ESC$THENBEGIN
MQ 2410 NN$=IP$
CJ 2420 IL=0:ML=2:PR$="ID ('RE
        TURN' FOR QUICK FORMAT
        ) :":GOSUB3060
XM 2430 IFIP$<>ESC$THENBEGIN
QP 2440 ID$=IP$
KC 2450 GOSUB2920
GX 2460 IFOK=1THENBEGIN
GJ 2470 OPEN15,DEV,15,"N"+STR$
        (DRV)+":"+NN$+","+ID$
MG 2480 GOSUB3750
XC 2490 CLOSE15
JQ 2500 BEND
FX 2510 BEND
GS 2520 BEND
CB 2530 BEND
RB 2540 BEND
ME 2550 GOSUB580:GOSUB2230
PD 2560 BEND
QF 2570 GOSUB580
JC 2580 RETURN
ME 2590 :
SX 2600 REM MOVE BLOCK
DK 2610 T1=TR:S1=SE:D1=DEV:D2=
        DRV
BF 2620 DO
RA 2630 PR$="MOVE TO TRACK (1-
        "+MID$(STR$(FNT(NS)),2
        )+") :":ML=2:GOSUB3060
KH 2640 LOOPUNTIL(INT(VAL(IP$)
        )>0ANDINT(VAL(IP$)<=FN
        T(NS)))ORIP$=ESC$
GJ 2650 IFIP$<>ESC$THENBEGIN
RB 2660 TR=INT(VAL(IP$))
AK 2670 DO
AX 2680 PR$="MOVE TO SECTOR (0
        -"+MID$(STR$(FNSC(TR))
        ,2)+") :":ML=2:GOSUB30
        60
FK 2690 LOOPUNTIL(INT(VAL(IP$)
        )>=0ANDINT(VAL(IP$))<=
        FNSC(TR))ORIP$=ESC$
MF 2700 IFIP$<>ESC$THENBEGIN
JQ 2710 SE=INT(VAL(IP$))
PQ 2720 DO
GK 2730 PR$="MOVE TO DRIVE (0/
        1) :":ML=1:GOSUB3060
DS 2740 LOOPUNTILIP$="0"ORIP$=
        "1"ORIP$=ESC$
KB 2750 IFIP$<>ESC$THENBEGIN
MS 2760 DRV=VAL(IP$)
FB 2770 DO
EK 2780 PR$="MOVE TO DEVICE (8
        -11) :":ML=2:GOSUB3060
JJ 2790 LOOPUNTIL(VAL(IP$)>7AN
        DVAL(IP$)<12)ORIP$=ESC
        $
QD 2800 IFIP$<>ESC$THENBEGIN
DP 2810 DEV=VAL(IP$)
QF 2820 GOSUB4050
AJ 2830 TR=T1:SE=S1:DEV=D1:DRV
        =D2
EF 2840 BEND
KF 2850 BEND
SE 2860 BEND
DH 2870 BEND
SK 2880 GOSUB580
MG 2890 RETURN
EG 2900 :
BR 2910 REM ASK ARE YOU SURE?
KQ 2920 OK=0
GM 2930 PR$="ARE YOU SURE (Y/N
        ) :":ML=1:GOSUB3060
JC 2940 IFIP$="Y"ORIP$="Y"THEN
        OK=1
BM 2950 GOSUB580
PM 2960 RETURN
PQ 2970 :
HB 2980 REM DISPLAY NEW DETAIL
        S
HE 2990 GOSUB3910
FR 3000 GOSUB4200
QC 3010 GOSUB4300
PF 3020 IFDF=1THENTR=T1:SE=S1:
        DF=0
HQ 3030 RETURN
XX 3040 :
CK 3050 REM GENERAL INPUT
GP 3060 IP$=""
XD 3070 POKE208,0
RJ 3080 WINDOW0,23,79,24,1
FJ 3090 CS$=CHR$(15)+"{@3
        {LEFT}"+CHR$(143)
FR 3100 PRINTPR$;CS$;
RC 3110 DO
DB 3120 GETK$
QH 3130 IFK$=CHR$(20)ANDLEN(IP
        $)>0THENBEGIN
BC 3140 PRINTK$;CS$;
KJ 3150 IP$=LEFT$(IP$,LEN(IP$)
        -1)
QG 3160 BEND
DS 3170 IFK$=CHR$(13)ANDLEN(IP
        $)=>1LTHENBEGIN
DP 3180 PRINT" ";
FP 3190 BEND
EP 3200 K=ASC(K$)
MD 3210 IF((K>31ANDK<127)ORK>1
        59)ANDLEN(IP$)<MLANDK<
        >34THENBEGIN
KK 3220 IP$=IP$+K$
GE 3230 PRINTK$;CS$;
AR 3240 BEND
CR 3250 LOOP UNTILK$=ESC$OR(K$
        =CHR$(13)ANDLEN(IP$)=>
        IL)
XQ 3260 IL=1:IFK$=ESC$THENIP$=
        K$
AQ 3270 RETURN
SX 3280 :
FF 3290 REM DISPLAY HEX GRID
FG 3300 WINDOW0,1,79,17,1
PP 3310 PRINTESC$"M";UC$;
MB 3320 PRINTRD$;"{3 SPACES}0
        {2 SPACES}1{2 SPACES}2
        {2 SPACES}3{2 SPACES}4
        {2 SPACES}5{2 SPACES}6
        {2 SPACES}7{2 SPACES}8
        {2 SPACES}9{2 SPACES}A
        {2 SPACES}B{2 SPACES}C
        {2 SPACES}D{2 SPACES}E
        {2 SPACES}F{12 SPACES}
        ";
KD 3330 PRINTHX$
AB 3340 FORA=0TO15
GA 3350 PRINTMID$(HX$,A+1,1);S
        PC(58);MID$(HX$,A+1,1)
KJ 3360 NEXTA
GR 3370 PRINTESC$"L";LC$;
CF 3380 RETURN
EH 3390 :
SH 3400 REM DISPLAY OPTIONS #1
ME 3410 WINDOW0,23,79,24,1
AS 3420 PRINTESC$"M";
AP 3430 PRINTRD$;"+: NEXT BLOC
        K{2 SPACES}B: NEW BLOC
        K{3 SPACES}@: HEX INPU
        T{3 SPACES}#: NEW DRIV
        E{3 SPACES}";
PE 3440 PRINT"W: WRITE BLOCK"
CS 3450 PRINT"-: LAST BLOCK
        {2 SPACES}L: LINK BLOC
        K{2 SPACES}T: TEXT INP
```

```
      UT{2 SPACES}D: NEW DEV
      ICE{2 SPACES}";
GF 3460 PRINT"N: NEXT MENU";ES
      C$"L";
FP 3470 RETURN
RM 3480 :
MS 3490 REM DISPLAY OPTIONS #2
BC 3500 WINDOW0,23,79,24,1
JB 3510 PRINTESC$"M";
XM 3520 PRINTRD$;"S: SEND COMM
      AND{2 SPACES}F: FORMAT
       DISK{4 SPACES}N: NEXT
       MENU{3 SPACES}Q: QUIT
       PROG."
AE 3530 PRINT"C: CATALOG DISK
      {2 SPACES}E: EXCHANGE
      {SPACE}DISK{2 SPACES}M
      : MOVE BLOCK";
BH 3540 PRINTESC$;"L";
KS 3550 RETURN
JB 3560 :
GK 3570 REM DISPLAY DISK INFO
JK 3580 WINDOW0,18,79,22,1
AM 3590 PRINTESC$"M";
GF 3600 PRINTBL$;"{A}**********
      ***{R}**************{R}
      ******************{R}**
      **************";
CP 3610 PRINT"**{R}**********
      ***{S}-";GR$;"TRACK:
      {2 SPACES},${2 SPACES}
      ";BL$;"-";GR$;"SECTOR:
      {2 SPACES},${2 SPACES}
      ";
CF 3620 PRINTBL$;"-";GR$;"LINK
       TRACK:{2 SPACES},$
      {2 SPACES}";BL$;"-";GR
      $;"LINK SECTOR:
      {2 SPACES},${2 SPACES}
      ";
DG 3630 PRINTBL$;"-";GR$;"BYTE
      S USED:{3 SPACES}";BL$
      ;"-"
BG 3640 PRINT"{Q}**********+
      **************{E}**{R}*
      **************{E}******
      *********{R}";
CG 3650 PRINT"**{E}******{R}**
      *****{W}"
FB 3660 PRINT"-";GR$;"POSITION
      :{3 SPACES}";BL$;"-";
AM 3670 PRINTGR$;"BYTE:
      {3 SPACES},${2 SPACES}
      ,'";CHR$(5);" ";GR$;"'
      ";BL$;"-";GR$;
MF 3680 PRINT"DISK:'
      {16 SPACES}', '
      {2 SPACES}' ";
QS 3690 PRINTBL$;"-";GR$;"DEVI
      CE:{2 SPACES}";BL$;"-"
      ;GR$;"DRIVE: ";BL$;"-"
      ;
JX 3700 PRINT"{Z}**********
      {E}**************{E}
      **********************
      ********{E}";
PD 3710 PRINT"*********{E}****
      ***{X}";ESC$"L";
HJ 3720 RETURN
XP 3730 :
MS 3740 REM CHECK ERROR
XR 3750 DF=0
CM 3760 INPUT#15,DN,DE$,DT$,DB
      $
KJ 3770 IFDN>19THENBEGIN
CR 3780 WINDOW0,23,79,24,1
RG 3790 PRINTESC$"M";
JQ 3800 PRINT"DISK ERROR :";DE
      $;",";DT$;",";DB$
GC 3810 PRINT"PRESS ANY KEY TO
       CONTINUE.";
KG 3820 PRINTESC$"L";
JD 3830 POKE208,0
FC 3840 GETKEYA$
AG 3850 GOSUB580
DF 3860 DF=1
JE 3870 BEND
CF 3880 RETURN
AH 3890 :
SJ 3900 REM GENERAL READ
ED 3910 POKE251,0:POKE252,28
FH 3920 OPEN15,DEV,15
QQ 3930 OPEN8,DEV,8,"#"
GH 3940 PRINT#15,"U1:8"+STR$(D
      RV)+STR$(TR)+STR$(SE)
AB 3950 GOSUB3750
AH 3960 IFDF=0THENBEGIN
SB 3970 SYS RD256
KH 3980 GOSUB3750
JQ 3990 BEND
ES 4000 CLOSE8
HC 4010 CLOSE15
HM 4020 RETURN
XR 4030 :
SF 4040 REM GENERAL WRITE
FF 4050 GOSUB2920
BE 4060 IF OK=1 THEN BEGIN
QF 4070 POKE251,0:POKE252,28
ER 4080 OPEN15,DEV,15
QM 4090 OPEN8,DEV,8,"#"
JC 4100 PRINT#15,"B-P:8 0"
EE 4110 SYS WT256
EC 4120 PRINT#15,"U2:8"+STR$(D
      RV)+STR$(TR)+STR$(SE)
BX 4130 GOSUB3750
RJ 4140 CLOSE8
BJ 4150 CLOSE15
PH 4160 BEND
XH 4170 RETURN
HG 4180 :
HF 4190 REM DISPLAY BOTH SETS
      {SPACE}OF BYTES
AE 4200 IFDF=0THENBEGIN
CR 4210 POKE251,0:POKE252,28
FH 4220 WINDOW0,0,79,24
EX 4230 PRINTLB$;
CC 4240 SYSDEC("1D0C"),2,2
XF 4250 SYSDEC("1D03"),140,221
      ,0
BR 4260 BEND
FS 4270 RETURN
KQ 4280 :
FQ 4290 REM FILL-IN INFO
SC 4300 IFDF=0THENBEGIN
CH 4310 PRINTESC$"M";
GS 4320 WINDOW0,18,79,22
CF 4330 B=TR:PRINTPK$;"{DOWN}
      {7 RIGHT}";:GOSUB4450:
      PRINT"{8 RIGHT}";:B=SE
      :GOSUB4450
CD 4340 B=PEEK(7168):PRINTLG$;
      "{12 RIGHT}";:GOSUB445
      0:PRINT"{13 RIGHT}";
PK 4350 B=PEEK(7169):GOSUB4450
      :LT=PEEK(7168):LS=PEEK
      (7169)
MX 4360 NB=256:IFLT>FNT(SD)ORL
      T=0THENNB=LS
SX 4370 PRINTMG$;"{12 RIGHT}";
      :B=NB:GOSUB4490:PRINT"
      {DOWN}{14 RIGHT}";
KQ 4380 PRINTYL$;"{24 RIGHT}";
      LEFT$(DD$,16);"
      {4 RIGHT}";RIGHT$(DD$,
      2);
ES 4390 PRINTPP$"{10 RIGHT}";:
      B=DEV:GOSUB4530:PRINT"
      {7 RIGHT}";MID$(STR$(D
      RV),2);
EM 4400 PRINTESC$"L";
KE 4410 BEND
BH 4420 RETURN
BH 4430 :
KR 4440 REM DISPLAY DEC, HEX
CJ 4450 PRINTRIGHT$("00"+MID$(
      STR$(B),2),2);"
      {2 RIGHT}";RIGHT$(HEX$
      (B),2);
FM 4460 RETURN
RJ 4470 :
FQ 4480 REM DISPLAY 3 BYTE NO
FS 4490 PRINTRIGHT$("00"+MID$(
      STR$(B),2),3);
RP 4500 RETURN
FM 4510 :
SQ 4520 REM DISPLAY 2 BYTE NO
DM 4530 PRINTRIGHT$("0"+MID$(S
      TR$(B),2),2);
BX 4540 RETURN
BX 4550 :
SM 4560 REM GET NAME OF NEW DI
      SK
CK 4570 T1=TR:S1=SE
EE 4580 TR=18:SE=0
CD 4590 DO
GP 4600 GOSUB3910
ME 4610 LOOPUNTILDS=0
JB 4620 TR=T1:SE=S1
MJ 4630 DD$="":FORA=0TO19:DD=P
      EEK(7312+A)
EG 4640 IFDD<32ORDD=34OR(DD>12
      7ANDDD<160)THENDD=32
MS 4650 DD$=DD$+CHR$(DD)
PX 4660 NS=1
GB 4670 IFPEEK(7171)=128THENNS
      =2
PR 4680 NEXTA
FF 4690 RETURN
FG 4700 :
MG 4710 REM TRAP ROUTINE
PP 4720 TRAP4720
QX 4730 IF ER<>30 THEN BEGIN
HC 4740 PRINT"{2 HOME}{CLR}A";
BD 4750 IFINSTR("AEIOU",LEFT$(
      ERR$(ER),1))<>0THENPRI
      NT"N";
KS 4760 PRINT" ";ERR$(ER);
ED 4770 PRINT" ERROR HAS OCCUR
      RED IN LINE ";EL
HE 4780 PRINT"PROGRAM ABORTED.
      "
FR 4790 END
FQ 4800 BEND
CQ 4810 RESUME NEXT
FS 4820 :
BM 4830 REM DATA FOR KEYS
EH 4840 DATA 40,73,43,74,28,42
      ,46,22,9,39,13,20,8,18
      ,21,14,36,62
```

Program 3: Sector Editor—ML

See instructions in article on page 57 before typing in.

```
1D00:4C 18 1D 4C 2E 1D 4C E7 35
1D08:1D 4C FC 1D 4C A5 1D 4C D4
1D10:5D 1F 4C 0E 1E 4C 4D 1E 06
1D18:A2 08 20 C6 FF A0 00 20 B8
1D20:CF FF 91 FB C8 D0 F8 4C FB
1D28:CC FF 00 00 00 00 8D 97 7B
1D30:1D 86 FD 84 FE A0 00 B1 CE
1D38:FB 48 A2 12 A5 FE 69 08 FB
1D40:20 73 1D E8 A5 FD 20 73 72
1D48:1D A2 1F AD 97 1D 20 73 5D
1D50:1D A2 12 A5 FE 20 73 1D DA
1D58:E8 A5 FD 20 73 1D A2 1F A6
1D60:68 20 73 1D E6 FD D0 02 E9
1D68:E6 FE C8 20 7F 1D 88 C8 3B
1D70:D0 C5 60 8E 00 D6 2C 00 2D
1D78:D6 10 FB 8D 01 D6 60 48 E6
1D80:98 48 29 0F D0 0D 18 A5 BF
1D88:FD 69 40 85 FD A5 FE 69 6A
1D90:00 85 FE 68 A8 68 60 00 3A
1D98:00 00 00 00 00 00 FF DA AD
1DA0:92 83 8C 00 00 8D 99 1D 1D
1DA8:8E 9A 1D A0 00 8C 98 1D FE
1DB0:AE 9A 1D AC 99 1D 20 F0 C9
```

```
1DB8:FF AC 98 1D B9 00 1C 20 29
1DC0:C2 B8 A9 20 20 D2 FF EE FC
1DC8:98 1D 20 D3 1D AD 98 1D C5
1DD0:D0 E7 60 AD 98 1D 29 0F EE
1DD8:D0 0C EE 9A 1D AE 9A 1D FB
1DE0:AC 99 1D 20 F0 FF 60 48 0E
1DE8:98 48 8A A2 12 20 73 1D 12
1DF0:E8 68 20 73 1D A2 1F 68 0F
1DF8:20 73 1D 60 A2 08 20 C9 09
1E00:FF A0 00 B1 FB 20 D2 FF 85
1E08:C8 D0 F8 4C CC FF 48 29 E0
1E10:03 69 08 8D 2C 1D 68 4A F2
1E18:4A 4A 29 01 18 69 30 8D 95
1E20:8B 1E A9 00 A8 20 68 FF 75
1E28:A9 08 AE 2C 1D A0 00 20 5F
1E30:BA FF A9 02 A2 8A A0 1E BD
1E38:20 BD FF 20 C0 FF A2 08 49
1E40:20 C6 FF 20 E4 FF 20 E4 8C
1E48:FF 20 CC FF 60 A2 08 20 E3
1E50:C6 FF 20 E4 FF 20 E4 FF 8C
1E58:D0 09 20 CC FF A9 08 20 E6
1E60:C3 FF 60 20 E4 FF 8D 14 E2
1E68:21 20 E4 FF 8D 15 21 20 FC
1E70:72 20 A9 20 20 D2 FF 20 91
1E78:E4 FF 20 D2 FF C9 00 D0 50
1E80:F6 A9 0D 20 D2 FF 20 CC E9
1E88:FF 60 24 30 00 00 AD 9E 5E
1E90:1D F0 0F AD A0 1D 8D A4 8D
1E98:1D AD 9F 1D 8D A3 1D 4C 16
1EA0:AE 1E AD A2 1D 8D A4 1D 21
1EA8:AD A1 1D 8D A3 1D AD 9C 2A
1EB0:1D 0A A8 B9 0D 1F 85 FB 9A
1EB8:B9 3D 1F 85 FD C8 B9 0D F0
1EC0:1F 85 FC B9 3D 1F 85 FE 99
1EC8:AC 9B 1D B9 2D 1F 18 65 FC
1ED0:FB 85 FB A5 FC 69 08 85 69
1ED8:FC AD 9B 1D 18 65 FD 85 1C
1EE0:FD A5 FE 69 08 85 FE A5 F5
1EE8:FC A2 12 20 73 1D E8 A5 18
1EF0:FB 20 73 1D A2 1F AD A3 04
1EF8:1D 20 73 1D CA A9 03 20 2F
1F00:73 1D A6 FE A4 FD AD A4 21
1F08:1D 20 E7 1D 60 A0 00 F0 22
1F10:00 40 01 90 01 E0 01 30 45
1F18:02 80 02 D0 02 20 03 70 CB
1F20:03 C0 03 10 04 60 04 B0 CB
1F28:04 00 05 50 05 01 04 07 49
1F30:0A 0D 10 13 16 19 1C 1F 56
1F38:22 25 28 2B 2E DD 00 2D 9E
1F40:01 7D 01 CD 01 1D 02 6D 49
1F48:02 BD 02 0D 03 5D 03 AD 49
1F50:03 FD 03 4D 04 9D 04 ED 51
1F58:04 3D 05 8D 05 8D 9B 1D 14
1F60:8E 9C 1D AD 9B 1D 29 0F 3E
1F68:8D 9B 1D AD 9C 1D 29 0F 8D
1F70:8D 9C 1D 20 F2 1F A0 80 18
1F78:A2 00 CA D0 FD 88 D0 F8 1B
1F80:A5 D5 C9 58 F0 FA C9 53 20
1F88:F0 1C C9 54 F0 21 C9 55 B9
1F90:F0 26 C9 56 F0 2B C9 33 6A
1F98:F0 30 C9 07 F0 3A C9 02 0B
1FA0:F0 3F 20 EA 1F 60 20 EA 7F
1FA8:1F CE 9C 1D 4C 63 1F 20 DD
1FB0:EA 1F EE 9C 1D 4C 63 1F D3
1FB8:20 EA 1F CE 9B 1D 4C 63 DF
1FC0:1F 20 EA 1F EE 9B 1D 4C 52
1FC8:63 1F 20 EA 1F A9 00 8D 60
1FD0:9B 1D 8D 9C 1D 4C 63 1F 9F
1FD8:A5 D3 29 01 F0 D1 4C A6 22
1FE0:1F A5 D3 29 01 F0 DA 4C F2
1FE8:B8 1F A9 00 8D 9E 1D 4C ED
1FF0:8E 1E 20 FD 1F A9 FF 8D 0F
1FF8:9E 1D 4C 8E 1E AD 9C 1D 3E
2000:0A 0A 0A 0A 0D 9B 1D 8D 48
2008:9D 1D 18 A2 03 A0 0A 20 5A
2010:F0 FF A9 05 20 D2 FF AD 48
2018:9D 1D 20 4A 20 20 17 FA C1
2020:1D 1D 1D 1D 1D 1D 00 AC B5
2028:9D 1D B9 00 1C 20 4A 20 CB
2030:20 17 FA 1D 1D 00 AC 9D 57
2038:1D B9 00 1C 20 C2 B8 B9 6E
2040:00 1C A2 06 A0 AC 20 E7 1C
2048:1D 60 A0 30 38 E9 64 90 09
2050:03 C8 B0 F9 A2 30 69 64 07
2058:38 E9 0A 90 03 E8 B0 F9 90
2060:69 3A 48 8A 48 98 20 D2 4D
2068:FF 68 20 D2 FF 68 20 D2 A8
2070:FF 60 A2 30 38 AD 14 21 E1
2078:E9 10 8D 14 21 AD 15 21 AF
2080:E9 27 8D 15 21 90 03 E8 BC
2088:B0 EB AD 14 21 69 10 8D 6F
2090:14 21 AD 15 21 69 27 8D B4
2098:15 21 8E 16 21 A2 30 38 0B
20A0:AD 14 21 E9 E8 8D 14 21 46
20A8:AD 15 21 E9 03 8D 15 21 61
20B0:90 03 E8 B0 EB AD 14 21 81
20B8:69 E8 8D 14 21 AD 15 21 E5
20C0:69 03 8D 15 21 8E 17 21 0C
20C8:A2 30 38 AD 14 21 E9 64 A5
20D0:8D 14 21 AD 15 21 E9 00 DC
20D8:8D 15 21 90 03 E8 B0 EB 5B
20E0:8E 18 21 AD 14 21 69 64 C9
20E8:38 A2 30 E9 0A 90 03 E8 14
20F0:B0 F9 8E 19 21 69 3A 8D 1C
20F8:1A 21 A0 00 B9 16 21 C9 D4
2100:30 D0 05 C8 C0 04 D0 F4 68
2108:B9 16 21 20 D2 FF C8 C0 BB
2110:05 D0 F5 60 00 00 00 00 CD
2118:00 00 00 00 00 00 00 00 5A
2120:00 60 00 00 00 00 00 00 7A
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Front Line

Article on page 26.

Program 1: Front Line Loader

```
JD 10 POKE 53280,0:POKE 53281,
      0:PRINT"{CLR}"
QF 20 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS INC. -
      {SPACE}ALL RIGHTS RESERV
      ED
FF 30 FOR D=1TO8:PRINT"{DOWN}"
      :NEXT
BM 40 PRINT"{8}{DOWN}{6 RIGHT}
      ...LOADING PLEASE WAIT..
      .{6 DOWN}"
SB 50 PRINT"{GRN}{2 SPACES}COP
      YRIGHT 1987 COMPUTE! PUB
      ., INC."
CP 60 PRINTTAB(9)"ALL RIGHTS R
      ESERVED{HOME}{DOWN}"
BC 70 POKE198,8:POKE631,19:POK
      E632,17:POKE633,17:FORN=
      0TO4:POKE634+N,13:NEXT
RS 80 PRINT"{BLK}POKE44,56:POK
      E43,1:POKE56*256,0:NEW"
RD 90 PRINT"{2 DOWN}LOAD"CHR$(
      34)"FRONT LINE.BAS"CHR$(
      34)",8"
XM 100 PRINT"{4 DOWN}RUN"
```

Program 2: Main Program—BASIC

```
ER 10 POKE 53280,11:POKE53281,
      0
EP 20 L=L+1:IFL=1THENPRINT"
      {CLR}"CHR$(8)CHR$(142):L
      OAD"FRONT LINE.ML",8,1
PX 30 SYS49155,12,10,"{7}F R O
      N T{4 SPACES}L I N E"
QX 40 CLR:DIM HP(55),PO(55),SP
      (55),AM(255),FS(55)
BD 50 FORN=40TO47
MJ 60 READPO(N):PO(N+8)=PO(N)
MX 70 READHP(N):HP(N+8)=HP(N)
MQ 80 READSP(N):SP(N+8)=SP(N)
CP 90 READFS(N):FS(N+8)=FS(N)
KG 100 READAM(N):AM(N+8)=AM(N)
GH 110 NEXT
HX 120 IFPEEK(788)<>49THEN180
RB 130 GOSUB1480
KQ 140 FORN=0TO111:READS:POKE1
      2560+N,S:NEXT
QB 150 GOSUB1550
RK 160 FORN=0TO63:READS:POKEN+
      832,S:NEXT
AM 170 FORN=0TO6:READCO:POKE53
      287+N,CO:NEXT:FORN=0TO2
      :POKE2044+N,13:NEXT
MJ 180 PO=49158
HC 190 HP=49160
GH 200 SP=49164
DJ 210 FS=49168
BC 220 AM=49172
CF 230 S1=1024
AG 240 S2=2023
QJ 250 C=54272
JH 260 JY=56320
SG 270 W=34
HR 280 AR=49152:REM ARENA
MS 290 LP=49155:REM LOCATE AND
       PRINT
BQ 300 C$(0)="{RED}":C$(1)="
      {7}"
SC 310 PC(0)=8:PC(1)=8
RC 320 WL(0)=40:WH(0)=47:WL(1)
      =48:WH(1)=55
MK 330 AM$(0)="AUTO":AM$(1)="S
      EMI"
PX 340 AM(0)=80:AM(1)=255
SQ 350 T$="{GRN}#${DOWN}
      {2 LEFT}%&"
GS 360 B$="{5}{4 +}{DOWN}
      {4 LEFT}{+}{RVS}
      {2 SPACES}{OFF}{+}
      {DOWN}{4 LEFT}{+}{RVS}
      {2 SPACES}{OFF}{+}
      {DOWN}{4 LEFT}{4 +}"
EC 370 POKE53269,112:POKE53271
      ,15:POKE53272,29:POKE53
      275,112:POKE53277,15
KX 380 POKE53256,57:POKE53258,
      169:POKE53260,32
AS 390 POKE53257,138:POKE53259
      ,154:POKE53261,138:POKE
      53264,64
KS 400 S=RND(-7):PRINT"{CLR}":
      FORN=1TO15:SYSLP,RND(1)
      *21+2,RND(1)*36+2,T$:NE
      XT
MP 410 S=RND(-TI/↑):FORN=40TO4
      7
QC 420 R=RND(1)*5:IFPEEK(2*(N-
      38)*40+1030+R)<>32THEN4
      20
CM 430 POKE2*(N-38)*40+1030+R,
      N:POKE2*(N-38)*40+1030+
      R+C,10:NEXT
EH 440 FORN=48TO55
KH 450 R=RND(1)*5:IFPEEK(2*(N-
      46)*40+1053+R)<>32THEN4
      50
JX 460 POKE2*(N-46)*40+1053+R,
      N:POKE2*(N-46)*40+1053+
      R+C,14:NEXT
CP 470 REM MAIN LOOP
AF 480 GOSUB1250
KF 490 Y=12:X=19:L=1523:CO=2:G
      OSUB830
XA 500 GOSUB650
XC 510 F1=(F1+1)AND1:IFF1=1THE
      N600
MG 520 IFOG<>32THENGOSUB890:IF
      F1=1THEN500
MP 530 OG=W:W=34:OC=2:F1=0:D=1
      :GOSUB820
CC 540 H1=PEEK(1509):H2=PEEK(1
      603):H3=PEEK(1538)
```

```
SK 550 IFH1=32ORH2=32ORH3=32TH
       EN580
RX 560 IFH1<WL(1)THENIFH2<WL(1
       )THENIFH3<WL(1)THENPC(1
       )=0
RQ 570 IFH1>WH(0)THENIFH2>WH(0
       )THENIFH3>WH(0)THENPC(0
       )=0
QM 580 IFPC(0)=0ORPC(1)=0THEN1
       270
MM 590 P=P+1AND1:GOTO480
KX 600 IFOG<WL(P)OROG>WH(P)THE
       NF1=0:GOTO500
CJ 610 W=OG:OG=32:CO=OC:CX=0:C
       Y=0
KP 620 PRINTC$(P)"{HOME}{RVS}
       {40 SPACES}"
FG 630 PRINTC$(P)"{HOME}{RVS}
       {SPACE}MOVEMENT"10-SP(W
       )"WEAPON:"AM$(AM(W))","
       HP(W)" STRENGTH"PO(W);
BJ 640 GOSUB840:GOTO500
RM 650 J=PEEK(JY+P):IF(JAND31)
       =31THENIFOG=32THEN650
EE 660 IFPEEK(JY+P)AND16THENGO
       SUB710:GOTO650
KS 670 IFNOTPEEK(JY+P)AND16THE
       N670
QS 680 IFF1=0THENIFOG=32THEN65
       0
ED 690 RETURN
PE 700 REM MOVE PIECE UNTIL FI
       RE BUTTON IS PRESSED
BM 710 OX=X:OY=Y:PX=CX:PY=CY
EM 720 IFNOTJAND8THENX=X+1:CX=
       CX+1
KG 730 IFNOTJAND4THENX=X-1:CX=
       CX-1
BJ 740 IFNOTJAND2THENY=Y+1:CY=
       CY+1
RB 750 IFNOTJAND1THENY=Y-1:CY=
       CY-1
CK 760 IFY>24ORY<1THENY=OY:CY=
       PY
XR 770 IFX>39ORX<0THENX=OX:CX=
       PX
MX 780 IFF1=0THEN810
DF 790 IFABS(CY)>10-SP(W)THENY
       =OY:CY=PY
HS 800 IFABS(CX)>10-SP(W)THENX
       =OX:CX=PX
RJ 810 L=S1+Y*40+X
BJ 820 POKEOL,OG:POKEOL+C,OC
SH 830 OL=L:OG=PEEK(L):OC=PEEK
       (C+L)
GE 840 IFF1=1THENPOKEL+C,1
MJ 850 POKEL+C,CO:IFD=1THEND=0
       :GOTO870
AE 860 POKEL,W
GQ 870 RETURN
AK 880 REM CHECK CHARACTER THA
       T PLAYER LANDED ON
CC 890 IF(OG>=WL(P))AND(OG<=WH
       (P))THENF1=1:RETURN
FE 900 IFNOT(OG>=WL(P+1AND1))A
       ND(OG<=WH(P+1AND1))THEN
       F1=1:RETURN
FC 910 REM PUT PLAYERS IN AREN
       A
QG 920 POKE53269,0
PR 930 F1=0:GOSUB1440:PRINT"
       {CLR}"
DP 940 SYSLP,5,6,B$:SYSLP,5,20
       ,B$
JC 950 SYSLP,16,6,B$:SYSLP,16,
       20,B$
RF 960 SYSLP,10,13,B$
AP 970 PRINT"{HOME}";:FORN=1TO
       12:PRINTSPC(30)"{RVS}
       {RED}{10 SPACES}";:NEXT
FK 980 FORN=1TO12:PRINTSPC(30)
       "{RVS}{BLU}{10 SPACES}"
       ;:NEXT
FA 990 FORN=2014TO2023:POKEN,1
       60:POKEN+C,6:NEXT
SC 1000 SYSLP,2,31,"{RVS}{RED}
       STRENGTH":SYSLP,15,31,
       "{RVS}{BLU}STRENGTH"
RD 1010 SYSLP,3,31,"{RVS}{5}::
       ::::::":SYSLP,16,31,"
       {RVS}::::::::"
MA 1020 POKEHP+P,HP(W):PO(W)=P
       O(W)+10:IFPO(W)>31THEN
       PO(W)=31
XC 1030 POKEPO+P,PO(W):POKESP+
       P,SP(W):POKEAM+P,AM(AM
       (W)):POKEFS+P,FS(W)
ER 1040 P=P+1AND1
PX 1050 POKEHP+P,HP(OG):POKEPO
       +P,PO(OG):POKESP+P,SP(
       OG):POKEAM+P,AM(AM(OG)
       )
PJ 1060 POKEFS+P,FS(OG)
RS 1070 P=P+1AND1
QF 1080 SYSLP,5,31,"{RVS}{RED}
       MOVE :"10-PEEK(SP)
QX 1090 SYSLP,18,31,"{RVS}
       {BLU}MOVE:"10-PEEK(SP+
       1)
PH 1100 SYSLP,7,31,"{RVS}{RED}
       WEAPON:";:SYSLP,9,31,A
       M$(-1*(PEEK(AM)=255))"
       ,"PEEK(HP)
XQ 1110 SYSLP,20,31,"{RVS}
       {BLU}WEAPON:";:SYSLP,2
       2,31,AM$(-1*(PEEK(AM+1
       )=255))","PEEK(HP+1)
XF 1120 SYS ARENA
HS 1130 POKE54296,0:WI=1:IFPEE
       K(PO)=0THENWI=2
BQ 1140 FORN=1TO30
PP 1150 PRINT"{HOME}{RVS}{WHT}
       {9 SPACES}PLAYER"STR$(
       WI)" WINS THE FIGHT
       {8 SPACES}"
AM 1160 PRINTC$(WI-1)"{HOME}
       {RVS}{9 SPACES}PLAYER"
       STR$(WI)" WINS THE FIG
       HT{8 SPACES}"
CG 1170 FORT=1TO50:NEXT:NEXT
CQ 1180 POKE 53269,0
EG 1190 PRINT"{CLR}":GOSUB1400
       :POKE53269,112
GB 1200 PO(W)=PEEK(PO+P):PO(OG
       )=PEEK(PO+(P+1AND1))
XD 1210 IFPEEK(PO+P)=0THENW=OG
       :CO=OC:PC(P)=PC(P)-1:R
       ETURN
BK 1220 P=P+1AND1:PC(P)=PC(P)-
       1
CQ 1230 RETURN
QS 1240 :
MB 1250 PRINTC$(P)"{HOME}{RVS}
       {15 SPACES}FRONT LINE
       {15 SPACES}":RETURN
BH 1260 REM GAME OVER
SB 1270 POKE53269,112:WI=1:IFP
       C(0)=0THENWI=2:
DH 1280 FORN=1TO20
SF 1290 PRINT"{HOME}{RVS}{WHT}
       {10 SPACES}PLAYER"STR$
       (WI)" WINS THE BATTLE
       {6 SPACES}"
BD 1300 FORT=1TO50:NEXT
JE 1310 PRINTC$(WI-1)"{HOME}
       {RVS}{10 SPACES}PLAYER
       "STR$(WI)" WINS THE BA
       TTLE{6 SPACES}"
MA 1320 FORT=1TO100:NEXT
BE 1330 NEXT
CM 1340 PRINT"{CLR}":POKE53272
       ,21:POKE53269,0
RP 1350 POKE 198,0:INPUT"{BLU}
       WANT TO PLAY AGAIN
       {3 SPACES}(Y/N)";CH$
KK 1360 IFCH$="Y"THENPRINT"
       {CLR}":POKE53272,29:GO
       TO30
HA 1370 IFCH$="N"THENEND
AJ 1380 GOTO1340
CQ 1390 REM RETRIEVE SCREEN
SP 1400 POKE781,4:POKE782,255:
       POKE88,0:POKE89,7:POKE
       90,0:POKE91,207:SYS419
       60
EX 1410 POKE781,4:POKE782,255:
       POKE88,0:POKE89,219:PO
       KE90,0:POKE91,203:SYS4
       1960
AJ 1420 RETURN
SG 1430 REM SAVE SCREEN
AM 1440 POKE781,4:POKE782,255:
       POKE88,0:POKE89,207:PO
       KE90,0:POKE91,7:SYS419
       60
FP 1450 POKE781,4:POKE782,255:
       POKE88,0:POKE89,203:PO
       KE90,0:POKE91,219:SYS4
       1960
QR 1460 RETURN
DX 1470 REM CHAR ROM
MR 1480 POKE56334,PEEK(56334)A
       ND254
XE 1490 POKE1,PEEK(1)AND251
QG 1500 POKE781,8:POKE782,255:
       POKE88,0:POKE89,55:POK
       E90,0:POKE91,215:SYS41
       960
KD 1510 POKE1,PEEK(1)OR4
QD 1520 POKE56334,PEEK(56334)O
       R1
SB 1530 RETURN
CC 1540 REM CREATE SPRITE SHAP
       ES FROM CHARS
EH 1550 FORN=2048TO2048+576:PO
       KEN,0:NEXT
GD 1560 FORN=0TO8
GG 1570 FORX=0TO7
PM 1580 POKE 2048+X*3+N*64,PEE
       K(12600+N*8+X)
KX 1590 NEXT:NEXT
HJ 1600 REM COPY CHARS
DF 1610 FORN=12640TO12671:POKE
       N+32,PEEK(N):POKEN+64,
       PEEK(N):NEXT
MK 1620 FORN=12608TO12639:POKE
       N+32,PEEK(N):NEXT
JH 1630 RETURN
MJ 1640 REM PLAYER DATA
BM 1650 DATA31,1 ,2 ,3 ,0
AQ 1660 DATA30,5 ,4 ,4 ,0
AA 1670 DATA10,8 ,4 ,5 ,1
PB 1680 DATA 8,14,5 ,2 ,1
ER 1690 DATA27,2 ,2 ,3 ,0
SB 1700 DATA25,6 ,3 ,5 ,0
QE 1710 DATA16,9 ,6 ,1 ,1
JE 1720 DATA10,10,5 ,2 ,1
DE 1730 REM SHAPE DATA-14 CHAR
       S,10 SPRITES
BP 1740 DATA231,129,129,0,0,12
       9,129,231
KA 1750 DATA0,1,20,43,4,27,45,
       58
GG 1760 DATA0,0,144,112,172,21
       6,108,186
AD 1770 DATA75,52,47,9,1,1,1,0
HA 1780 DATA200,116,236,152,0,
       0,128,0
EA 1790 DATA0,0,0,24,0,0,0,0
PH 1800 DATA24,16,56,63,30,17,
       34,64
JR 1810 DATA24,16,56,63,24,20,
       114,2
FM 1820 DATA24,16,56,63,24,12,
       24,8
CM 1830 DATA24,16,56,63,28,18,
       20,32
JD 1840 DATA24,8,28,252,120,13
       6,68,2
```

```
GK 1850 DATA24,8,28,252,24,40,
        78,64
QS 1860 DATA24,8,28,252,24,48,
        24,16
GC 1870 DATA24,8,28,252,56,72,
        40,4
KH 1880 REM HILL SPRITE
HS 1890 DATA 0,0,0,0,0,0,0,0,0
GX 1900 DATA 0,0,0,0,0,0,0,0,0
BS 1910 DATA 0,0,0,0,0,0,0,0,0
QR 1920 DATA 0,0,0,0,0,0,0,0,0
XQ 1930 DATA 0,0,0,0,0,0,0,0,0
BP 1940 DATA 0,0,0,0,0,0,0,126,0
QJ 1950 DATA 3,255,128,7,191,2
        24,30,237
BM 1960 DATA 240,27,191,216,3,
        38,128,0
BD 1970 REM COLOR DATA
FG 1980 DATA 2,6,8,8,9,9,9
```

Program 3: Main Program—ML

See instructions in article on page 26 before typing in.

```
C000:4C 49 C0 4C 1C C3 20 20 27
C008:01 01 01 01 02 04 01 01 9D
C010:02 07 01 01 64 FF 00 07 AE
C018:21 26 06 00 04 00 08 00 A4
C020:00 00 00 01 00 FF 00 97 49
C028:04 9F 06 65 47 48 67 0A DE
C030:0A 01 00 FF 00 80 3F 02 79
C038:06 00 00 00 00 00 00 00 BC
C040:00 00 00 00 00 00 00 00 C1
C048:00 A9 21 8D F8 07 A9 25 8D
C050:8D F9 07 A9 20 8D FA 07 C6
C058:8D FB 07 A9 00 85 04 8D C6
C060:3A C0 A9 03 8D 15 D0 A9 A0
C068:33 8D 01 D0 A9 19 8D 00 E0
C070:D0 A9 EA 8D 03 D0 A9 F6 A0
C078:8D 02 D0 A9 0F 8D 18 D4 A9
C080:AD 27 D0 8D 37 C0 AD 28 D5
C088:D0 8D 38 C0 A2 01 20 DE 21
C090:C2 E6 04 A2 00 20 DE C2 D8
C098:78 A9 86 8D 14 03 A9 C3 2E
C0A0:8D 15 03 58 20 10 C3 85 62
C0A8:04 20 D3 C0 20 0B C3 8C FB
C0B0:44 C0 CE 3B C0 D0 08 A9 15
C0B8:03 8D 3B C0 20 21 C1 20 BB
C0C0:27 C2 20 85 C2 90 01 60 9D
C0C8:20 BA C1 A0 02 20 15 C3 C9
C0D0:4C A4 C0 A4 04 B9 00 DC E7
C0D8:A0 00 A2 00 4A B0 01 88 9E
C0E0:4A B0 01 C8 4A B0 01 CA 42
C0E8:4A B0 01 E8 98 48 20 0B 9B
C0F0:C3 68 99 20 C0 8A 99 1F 26
C0F8:C0 D9 31 C0 F0 0C B9 20 CE
C100:C0 D0 07 A9 01 A6 04 9D DB
C108:2F C0 60 A6 04 DE 0E C0 42
C110:D0 09 BD 10 C0 9D 0E C0 50
C118:4C 3F C1 A9 00 8D 39 C0 CD
C120:60 A6 04 DE 0A C0 D0 E2 C3
C128:BD 0C C0 9D 0A C0 20 37 4A
C130:C3 20 0B C3 B9 1F C0 F0 F7
C138:06 B9 1F C0 99 31 C0 A9 D9
C140:00 8D 39 C0 AC 44 C0 B9 0C
C148:20 C0 18 79 01 D0 C9 32 B7
C150:90 62 C9 EB B0 5E 99 3D 1C
C158:C0 AC 44 C0 B9 1F C0 18 DF
C160:79 00 D0 C9 F8 F0 4D C9 47
C168:18 90 49 99 3C C0 38 E9 1E
C170:14 4A 4A 4A 48 B9 3D C0 E2
C178:38 E9 30 4A 4A 4A AA 68 76
C180:A8 18 20 F0 FF B1 D1 C9 A5
C188:A0 F0 29 C8 B1 D1 C9 A0 53
C190:F0 22 98 18 69 27 A8 B1 94
C198:D1 C9 A0 F0 17 C8 B1 D1 AB
C1A0:C9 A0 F0 10 AC 44 C0 B9 02
C1A8:3D C0 99 01 D0 B9 3C C0 E4
C1B0:99 00 D0 60 A9 01 8D 39 C6
C1B8:C0 60 20 0B C3 B9 1B C0 65
C1C0:D0 64 A6 04 BD 12 C0 F0 83
C1C8:05 DE 12 C0 D0 58 BD 00 38
C1D0:DC 29 10 D0 51 B9 00 D0 5E
C1D8:99 04 D0 B9 01 D0 99 05 63
C1E0:D0 B9 1F C0 D0 03 B9 31 62
C1E8:C0 99 23 C0 B9 20 C0 99 0D
C1F0:24 C0 B9 1C C0 0D 15 D0 E4
C1F8:8D 15 D0 A9 01 99 1B C0 A2
C200:A6 04 BD 14 C0 9D 12 C0 34
C208:BD 16 C0 AA A9 10 9D 04 81
C210:D4 A9 11 9D 04 D4 A9 0A 37
C218:9D 05 D4 A4 04 B9 35 C0 C4
C220:99 45 C0 9D 01 D4 60 20 F1
C228:0B C3 B9 1B C0 F0 50 A6 1E
C230:04 BD 16 C0 AA A4 04 B9 9F
C238:45 C0 4A 4A 9D 01 D4 A4 BD
C240:04 C8 C8 98 0A 8D 44 C0 6C
C248:20 0B C1 AD 39 C0 F0 D6 39
C250:20 0B C3 B9 1C C0 49 FF 33
C258:2D 15 D0 8D 15 D0 A9 00 EB
C260:99 1B C0 99 05 D0 99 04 CD
C268:D0 A6 04 BD 16 C0 AA A9 0F
C270:81 9D 04 D4 A9 02 9D 01 7D
C278:D4 A9 05 9D 05 D4 60 A0 2A
C280:0A 20 15 C3 60 20 0B C3 4F
C288:B9 1B C0 F0 4F 20 10 C3 B7
C290:0A AA B9 05 D0 18 69 07 0E
C298:38 FD 01 D0 10 02 49 00 02
C2A0:C9 0F B0 38 B9 04 D0 18 FF
C2A8:69 07 38 FD 00 D0 10 02 F0
C2B0:49 00 C9 0F B0 26 20 50 B3
C2B8:C2 20 10 C3 AA A9 19 9D B1
C2C0:47 C0 A4 04 BD 06 C0 8D 04
C2C8:3A C0 38 F9 08 C0 B0 02 E8
C2D0:A9 00 9D 06 C0 D0 07 20 B6
C2D8:DE C2 38 60 18 60 20 10 1E
C2E0:C3 0A A8 B9 27 C0 85 AA 6D
C2E8:B9 28 C0 85 AB AD 3A C0 0F
C2F0:4A 4A A8 A9 BA 91 AA BD 0D
C2F8:06 C0 48 29 03 AA 68 4A 2B
C300:4A A8 BD 2B C0 09 80 91 FD
C308:AA 18 60 A5 04 0A A8 60 4B
C310:A5 04 49 01 60 A2 00 CA FC
C318:88 D0 FA 60 20 9B B7 8A E6
C320:48 20 9B B7 8A A8 68 AA 35
C328:18 20 F0 FF 20 73 00 C9 7A
C330:20 F0 03 4C A0 AA 60 A6 40
C338:04 DE 2F C0 D0 41 AD 1A 6C
C340:C0 9D 2F C0 20 0B C3 B9 EF
C348:1F C0 D0 08 B9 20 C0 F0 EA
C350:2E B9 31 C0 30 16 FE 18 7F
C358:C0 BD 18 C0 C9 21 90 04 B6
C360:C9 25 90 1B A9 21 9D 18 FE
C368:C0 4C 7F C3 FE 18 C0 BD 27
C370:18 C0 C9 25 90 04 C9 29 11
C378:90 05 A9 25 9D 18 C0 BD 9D
C380:18 C0 9D F8 07 60 AD 45 E1
C388:C0 38 E9 4A 8D 45 C0 AD 11
C390:46 C0 38 E9 4A 8D 46 C0 E6
C398:AD 37 C0 8D 27 D0 AD 47 D4
C3A0:C0 F0 06 8D 27 D0 CE 47 BF
C3A8:C0 AD 38 C0 8D 28 D0 AD 6B
C3B0:48 C0 F0 06 8D 28 D0 CE 88
C3B8:48 C0 4C 31 EA 00 00 00 88
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Dynamusic

Article on page 62.

Program 1: Dynamusic Translator

```
KC 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS, INC. -
       ALL RIGHTS RESERVED
MQ 20 LN=8000
RQ 30 GOTO100
DE 40 POKES+1,70:POKES+5,7:POK
      ES+4,17:GOSUB60:RETURN
XK 50 POKES+1,6:POKES+5,9:POKE
      S+4,33:GOSUB60:RETURN
MC 60 FORJ=1TO25:NEXT:FORJ=STO
      S+5:POKEJ,0:NEXT:RETURN
BR 70 GETX$:IFX$=""THEN70
KE 80 RETURN
MX 90 T$=STR$(T):T$=RIGHT$(T$,
      LEN(T$)-1):RETURN
JC 100 POKE53281,0:POKE53280,0
      :PRINTCHR$(14)"{2 DOWN}
FC 110 PRINT"{CLR}{8
       SPACES}COPYRIGHT 198
       7 COMPUTE! PUB., INC."
XH 120 PRINTTAB(9)"ALL RIGHTS
       {SPACE}RESERVED{2 DOWN}
       "
AG 130 PRINT"{7}WHAT IS THE OC
       TAVE?":S=54272:POKES+24
       ,15:Z$="{5 DOWN}"
EF 140 PRINT"{2 DOWN}HIT","{5
       0 THRU 7{7}","TO INDICA
       TE":PRINT,,"OCTAVE NUMB
       ER."
HD 150 PRINT,"{DOWN}{5}RETURN
       {7}","TO INDICATE A RES
       T.":PRINT,"{DOWN}{5}Q
       {7}","TO QUIT."
QQ 160 PRINTZ$"{GRN}MIDDLE C B
       EGINS OCTAVE 4, WHICH R
       UNS{4 SPACES}UPWARD TO
       {SPACE}INCLUDE ";
FK 170 PRINT"THE B ABOVE MIDDL
       E C. THE OCTAVE ABOVE I
       S 5 AND THE OCTAVE "
FQ 180 PRINT"BELOW MIDDLE C IS
        3, ETC.{7}
BA 190 GOSUB70:C$=X$:IFC$<>"Q"
       THEN280
EJ 200 PRINT"{CLR}ENTER {5}Y
       {7} IF YOU REALLY WANT
       {SPACE}TO QUIT."
CH 210 GOSUB70:IFX$<>"Y"THENPR
       INT"{CLR}":GOTO130
CC 220 PRINT"{CLR}THE ENTRY ST
       AGE IS COMPLETE."
BQ 230 PRINT"{DOWN}HIT {5}C{7}
        TO CYCLE THE MUSIC OVE
       R AND OVER.
CM 240 PRINT"{DOWN}ANY OTHER K
       EY TO PLAY THE MUSIC ON
       CE{4 SPACES}EACH TIME I
       T IS CALLED."
RA 250 GOSUB70:L$="0":H$="0":U
       $="0"
DE 260 IFX$="C"THENL$="1"
DB 270 GOSUB40:GOTO830
KX 280 C=VAL(C$):IFC$=CHR$(13)
       THEN:C$="REST":L=0:H=0:
       GOSUB40:GOTO410
CX 290 IFC$<"0"ORC$>"7"THENGOS
       UB50:GOTO190
AM 300 GOSUB40:PRINT"{CLR}"Z$"
       {UP}OCTAVE IS{RED}"C
FX 310 PRINT"{2 DOWN}{7}ENTER
       {SPACE}THE LETTER NAME
       {SPACE}OF THE NOTE
PX 320 PRINT"FOLLOWED BY AN
       {5}S{7}' FOR A SHARP OR
        AN '{5}F{7}'FOR A FLAT

JM 330 PRINT"{DOWN}KEEP ALL EN
       TRIES LOWER CASE.
EM 340 INPUT"{2 DOWN}WHAT IS T
       HE NOTE";N$
AF 350 FORJ=0TO16:READA$,N:IFN
       $=A$THEN390
AM 360 NEXT:RESTORE:GOSUB50
GE 370 PRINT"{DOWN}PLEASE ENTE
       R:","{5}C,CS,DF,D,DS,EF
       ,E,F",,,"FS,G,GS,AF,A,B
       F,OR B{7}"
RQ 380 GOTO340
```

```
QM 390 GOSUB40:X=ASC(LEFT$(N$,
       1)):X=X+128:W$=CHR$(X):
       N$=W$+MID$(N$,2,1)
AH 400 Q=440*1.05946309↑(N-10)
       *2↑(C-4):V=Q/.06096:H=I
       NT(V/256):L=INT(V-(H*25
       6))
JG 410 PRINT"{CLR}"Z$"VALID EN
       TRIES ARE: {5}1,2,4,8,1
       6,32,OR 64{7}"
SK 420 PRINT"{DOWN}{5}1{7}
       {2 SPACES}FOR A WHOLE N
       OTE OR REST."
DS 430 PRINT"{5}4{7}{2 SPACES}
       FOR A QUARTER NOTE OR R
       EST."
SD 440 PRINT"{5}32{7} FOR A 32
       ND NOTE OR REST, ETC."
ED 450 PRINT"{DOWN}PLACE A PER
       IOD AFTER THE NUMBER TO
       {6 SPACES}DOT IT.
       {2 SPACES}{GRN}DOTTED N
       OTES";
ER 460 PRINT" ARE HELD HALF
       {5 SPACES}AGAIN AS LONG
        AS UNDOTTED NOTES.{7}"
MB 470 PRINTZ$"ENTER {5}D{7} T
       O BYPASS THE ABOVE PROC
       ESS, SO YOU CALCULATE T
       HE";
HA 480 PRINT" {5}D{7}URATION A
       ND PLACE IT DIRECTLY IN
        THE CREATED DATA STATE
       MENT."
QC 490 PRINT"{HOME}{DOWN}
       {13 SPACES}{HOME}PLEASE
        ENTER THE NOTE OR REST
        VALUE."
FG 500 INPUT U$:U=VAL(U$)
KP 510 IFU$><"D"THEN570
RF 520 PRINT"{CLR}ENTER YOUR C
       ALCULATED DURATION."
RQ 530 INPUTDR$
XQ 540 DR=VAL(DR$)
EF 550 IFDR<0ORDR>255THENGOSUB
       50:GOTO520
EH 560 GOTO620
GA 570 FORJ=0TO6:IF2↑J=UTHEN60
       0
QG 580 NEXT
EH 590 GOSUB50:GOTO490:REM REJ
       ECT
CC 600 U=128/U:REM ACCEPT
EG 610 IFRIGHT$(U$,1)="."THENU
       =U*1.5
XF 620 GOSUB40:PRINT"{CLR}HERE
        IS YOUR NOTE:{4 DOWN}"
JC 630 PRINT"OCTAVE{RED} "C$"
       {RIGHT}{7}NOTE {RED}"N$
       "{7}{2 RIGHT}VALUE
       {RED}";
DF 640 IFDRTHENPRINT"{7}
       {6 LEFT}DURATION{RED}"D
       R:GOTO670
QK 650 IFU$="1"THENPRINT"1":GO
       TO670
AA 660 PRINT"1/"U$
KP 670 PRINT"{7}{3 DOWN}HIT","
       {5}RETURN{7}","TO ADD T
       HE DATA LINE",,"TO THE
       {SPACE}PROGRAM.
RM 680 PRINT,"{2 DOWN}{5}E{7}"
       ,"TO ERASE THIS DATA.
MM 690 PRINT"{2 DOWN}{5}","R
       {7}","TO ADD A REMARK T
       O",,,"THE DATA LINE.
QQ 700 GOSUB70:D$=X$
DG 710 IFD$="R"ORD$=CHR$(13)TH
       EN740
EP 720 IFD$="E"THENGOSUB40:PRI
       NT"{CLR}"Z$:RESTORE:GOT
       O130
DA 730 GOSUB50:PRINT"ENTER {5}
       RETURN{7}, E, OR R{7}":GOT
       O700
EC 740 GOSUB40:GOSUB40:T=L:GOS
       UB90:L$=T$
BD 750 T=H:GOSUB90:H$=T$
HH 760 IFDRTHENU=DR
MA 770 T=U:GOSUB90:U$=T$
KX 780 IFD$<>"R"THEN830
GR 790 PRINT"{CLR}"Z$"MAXIMUM
       {SPACE}REMARK LENGTH 50
        CHARACTERS.
JH 800 INPUT"{2 DOWN}WHAT IS Y
       OUR REMARK";R$
GE 810 IFLEN(R$)>49THENGOSUB50
       :GOTO800
SM 820 GOSUB40:R$=":REM "+R$
DG 830 PRINT"{CLR}{RED}
       {3 DOWN}"LN"DATA"L$","H
       $","U$;R$
PE 840 PRINT"{BLK}LN="LN+1;
HB 850 IFC$="Q"THEN PRINT":GOT
       O880{HOME}":GOTO870
HS 860 PRINT":GOTO130{HOME}"
FP 870 POKE631,13:POKE632,13:P
       OKE198,2:END
FP 880 S=54272:PRINT"{7}VALUE
       {SPACE}TO MULTIPLY EACH
        NOTE DURATION BY
       {2 SPACES}1{3 LEFT}";
GX 890 INPUTM
FR 900 PRINT"{DOWN}WANT MUSIC
       {SPACE}POKED TO RAM?"
QD 910 GOSUB70:IFX$="Y"THENGOS
       UB960
FX 920 PRINT"{DOWN}WANT MUSIC
       {SPACE}FILE SAVED?":GOS
       UB70:IFX$="Y"THENGOSUB1
       020
MA 930 END
KA 940 DATAC,1,CS,2,DF,2,D,3,D
       S,4,EF,4,E,5,ES,6,F,6,F
       S,7,G,8
XE 950 DATAGS,9,AF,9,A,10,AS,1
       1,BF,11,B,12
KR 960 INPUT"{7}{DOWN}ADDRESS
       {SPACE}TO POKE MUSIC
       {2 SPACES}40960{7 LEFT}
       ";B$:B=VAL(B$)
HF 970 IFB<820ORB>65535THENGOS
       UB50:GOTO960
PB 980 PRINT"{7}{2 DOWN}DATA I
       S BEING POKED":PRINT"ST
       ARTING AT LINE"B:J=B:GO
       SUB1090
RJ 990 GOSUB1010:POKEJ,L:POKEJ
       +1,H:POKEJ+2,U:J=J+3:IF
       U>0THEN990
SQ 1000 PRINT"{2 DOWN}ENDING A
        DDRESS IS"J:PRINT"MUSI
        C IS IN MEMORY.":RESTO
        RE:RETURN
SR 1010 READL,H,U:U=U*M:RETURN
QR 1020 INPUT"{DOWN}NAME OF SA
        VED FILE";NF$
HB 1030 PRINT"{CLR}{DOWN}ADDRE
        SS YOU WANT THIS FILE
        {SPACE}TO LOAD AT
        {3 SPACES}LATER
        {2 SPACES}40960
        {7 LEFT}";
QE 1040 INPUT AD$:AD=VAL(AD$):
        IFAD<819ORAD>65536THEN
        GOSUB50:GOTO1040
KD 1050 HB=INT(AD/256):LB=AD-2
        56*HB:OPEN2,8,2,"0:"+N
        F$+",P,W"
PS 1060 PRINT#2,CHR$(LB);CHR$(
        HB);:GOSUB1090
XP 1070 GOSUB1010:PRINT#2,CHR$
        (L);CHR$(H);CHR$(U);:I
        FU>0THEN1070
DF 1080 CLOSE2:PRINT"SAVE COMP
        LETE.":RETURN
PM 1090 FORI=1TO34:READU$:NEXT
        :RETURN
```

Program 2: Dynamusic Player

See instructions in article on page 62 before typing in.

```
9E00:20 2D 9F AD 14 03 8D 85 B4
9E08:9F AD 15 03 8D 86 9F 78 91
9E10:A9 2D 8D 14 03 A9 9E 8D E9
9E18:15 03 58 60 78 AD 85 9F D6
9E20:8D 14 03 AD 86 9F 8D 15 47
9E28:03 58 6C 14 03 AD 00 9E 39
9E30:C9 00 D0 08 A9 20 8D 00 D5
9E38:9E 4C 20 9F EE 8A 9F EE A5
9E40:8E 9F EE 92 9F AD 8B 9F 1E
9E48:CD 8A 9F D0 2B 20 E1 9E 4C
9E50:AD 6D 9F 29 FE 8D 04 D4 51
9E58:AE 88 9F E0 00 F0 0E 8E 7F
9E60:01 D4 AE 87 9F 8E 00 D4 AD
9E68:09 01 8D 04 D4 A9 00 8D 37
9E70:8A 9F AD 89 9F 8D 8B 9F 13
9E78:AD 8D 9F CD 8E 9F D0 2B 80
9E80:20 E1 9E AD 74 9F 29 FE 68
9E88:8D 0B D4 AE 88 9F E0 00 59
9E90:F0 0E 8E 08 D4 AE 87 9F 2C
9E98:8E 07 D4 09 01 8D 0B D4 33
9EA0:A9 00 8D 8E 9F AD 89 9F B3
9EA8:8D 8D 9F AD 91 9F CD 92 18
9EB0:9F D0 2B 20 E1 9E AD 7B B9
9EB8:9F 29 FE 8D 12 D4 AE 88 92
9EC0:9F E0 00 F0 0E 8E 0F D4 B2
9EC8:AE 87 9F 8E 0E D4 09 01 F2
9ED0:8D 12 D4 A9 00 8D 92 9F 89
9ED8:AD 89 9F 8D 91 9F 6C 85 85
9EE0:9F A0 00 A5 01 29 FC 85 9C
9EE8:01 B9 00 A0 99 87 9F C8 12
9EF0:C0 03 D0 F5 A8 A5 01 09 AF
9EF8:03 85 01 C0 00 F0 12 AD DA
9F00:EA 9E 18 69 03 8D EA 9E B8
9F08:AD EB 9E 69 00 8D EB 9E 30
9F10:60 68 68 AD 87 9F C9 00 CF
9F18:F0 06 20 2D 9F 6C 85 9F 81
9F20:A0 00 99 00 D4 C8 C0 19 47
9F28:D0 F8 4C 1C 9E 20 5B 9F 25
9F30:A9 00 A8 99 87 9F C8 C0 FF
9F38:10 D0 F8 A9 02 8D 8B 9F 6A
9F40:8D 8D 9F 8D 91 9F A9 00 D4
9F48:8D EA 9E A9 A0 8D EB 9E 29
9F50:A5 38 C9 A0 D0 04 A9 9D 3B
9F58:85 38 60 A0 00 B9 69 9F D7
9F60:99 00 D4 C8 C0 19 D0 F5 95
9F68:60 00 00 FF 00 40 09 00 EA
9F70:00 00 FF 00 40 09 00 00 D5
9F78:00 FF 00 40 09 00 00 00 04
9F80:00 0F 60 31 EA FF FB A8 9A
9F88:00 FF 00 FF 00 FF 00 FF C7
9F90:00 00 00 00 00 00 00 00 CF
```

Program 3: Dynamusic Customizer

```
JJ 10 PRINT"{CLR}{RVS}{BLK}DYN
      AMUSIC CUSTOMIZER{DOWN}"
PQ 20 INPUT"NAME OF FILE TO BE
       SAVED";N$
XJ 30 A=40448:S=A:E=40833
KC 40 H=INT(A/256):L=A-256*H:O
      PEN2,8,2,"0:"+N$+",P,W":
      PRINT#2,CHR$(L);CHR$(H);
GC 50 FORJ=STOE:PRINT#2,CHR$(P
      EEK(J));
FE 60 IFST>0THENPRINT"SAVE ERR
      OR.":PRINT#2:CLOSE2:END
AS 70 NEXT:CLOSE2:PRINT"SAVE C
      OMPLETE."
```

Program 4: Elite Demo

See instructions in article on page 62 before typing in.

```
A000:00 00 2D 00 00 2D 77 07 91
A008:12 61 08 12 68 09 12 BE 17
A010:3B 12 DF 1D 12 F7 09 12 D5
```

```
A018:DF 27 09 00 00 09 0F 43 B9
A020:09 EF 13 12 EF 0E 12 DF 21
A028:27 09 3C 32 09 EF 13 12 2A
A030:8F 0C 12 BE 3B 12 68 09 66
A038:12 68 09 12 DF 27 09 0F 9B
A040:43 09 87 21 09 F7 09 12 B4
A048:00 00 09 DF 27 09 3C 32 B0
A050:09 00 00 09 30 0B 12 BE 37
A058:3B 12 DF 1D 12 8F 0C 12 82
A060:0F 43 12 87 21 12 18 0E 44
A068:12 BE 3B 09 DF 1D 09 C1 A1
A070:2C 09 60 16 09 77 07 12 BD
A078:DF 1D 09 EF 0E 09 3C 32 50
A080:09 D1 12 12 EF 0E 12 DF D9
A088:1D 09 A2 25 09 00 00 09 92
A090:98 05 12 C1 2C 12 00 00 67
A098:09 D1 12 12 30 0B 12 DF E7
A0A0:1D 09 3C 32 09 1E 19 09 59
A0A8:77 07 12 DF 1D 09 00 00 B4
A0B0:09 A2 25 09 DF 1D 12 30 1C
A0B8:0B 12 83 59 12 60 16 09 51
A0C0:30 0B 12 C1 2C 12 60 16 BB
A0C8:12 EF 0E 12 85 23 12 1F ED
A0D0:15 12 ED 05 12 DF 1D 09 82
A0D8:DA 0B 09 85 23 09 1F 15 54
A0E0:09 E1 08 12 DF 1D 09 C2 89
A0E8:11 09 87 21 09 EF 0E 09 25
A0F0:77 07 12 85 23 12 1F 15 FE
A0F8:12 ED 05 12 DF 1D 09 00 06
A100:00 09 A2 25 09 60 16 09 2B
A108:98 05 12 DF 1D 09 30 0B 91
A110:09 87 21 09 D1 12 09 68 BF
A118:09 12 A2 25 12 60 16 12 5B
A120:77 07 12 A2 25 12 60 16 95
A128:12 98 05 12 C1 2C 12 60 9F
A130:16 12 61 08 12 87 21 09 A9
A138:C3 10 09 3C 32 09 EF 13 EE
A140:12 18 0E 12 C3 10 09 DF C5
A148:27 09 30 0B 12 98 05 12 27
A150:63 38 12 EF 13 12 30 0B E0
A158:12 BE 3B 1B D1 12 12 EF 58
A160:0E 12 00 00 12 00 00 12 D1
A168:00 00 12 BE 3B 12 A2 25 66
A170:12 77 07 12 00 00 5A 00 51
A178:00 5A 00 00 5A 01 00 00 29
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

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Sprite Flip

Article on page 52.

Program 1: Sprite Flip

```
CH 10 REM COPYRIGHT 1987 COMPU
      TE! PUBLICATIONS, INC. A
      LL RIGHTS RESERVED
SE 20 POKE 53280,0:POKE 53281,
      0:PRINTCHR$(14)"{CLR}
      {DOWN}{8 SPACES}CREATING ML..."
DF 30 FORT=49152TO49329:READH:
      POKET,H:CK=CK+H:NEXT
CP 40 IF CK<>25249 THEN PRINT
      {SPACE}"ERROR IN DATA."
SE 50 DATA76,68,192,76,65,192
EA 60 DATA165,251,72,165,252,7
      2
DE 70 DATA32,145,192,32,54,192
XF 80 DATA160,0,162,60,32,46
ME 90 DATA192,32,46,192,32,46
EE 100 DATA192,202,202,202,202
      ,202
SM 110 DATA202,16,239,104,133,
      252
BR 120 DATA104,133,251,96,189,
      180
MR 130 DATA192,145,251,200,232
      ,96
CK 140 DATA160,63,177,251,153,
      180
KF 150 DATA192,136,16,248,96,5
      6
QM 160 DATA176,1,24,169,0,105
HR 170 DATA0,141,178,192,165,2
      51
PK 180 DATA72,165,252,72,32,14
      5
FP 190 DATA192,32,54,192,160,0
PJ 200 DATA185,180,192,72,185,
      182
CC 210 DATA192,153,180,192,104
      ,153
PD 220 DATA182,192,200,200,200
      ,192
CF 230 DATA66,208,235,160,63,1
      85
EF 240 DATA180,192,174,178,192
      ,208
BF 250 DATA39,162,7,74,46,179
GA 260 DATA192,202,16,249,173,
      179
GJ 270 DATA192,145,251,136,16,
      231
HM 280 DATA104,133,252,104,133
      ,251
SE 290 DATA96,169,0,133,251,13
      4
FK 300 DATA252,70,252,102,251,
      70
XC 310 DATA252,102,251,96,162,
      7
CC 320 DATA74,8,74,46,179,192
GA 330 DATA40,46,179,192,202,2
      02
BA 340 DATA16,242,48,208
```

Program 2: Sprite Flip Demo

```
BQ 10 REM COPYRIGHT 1987 - COM
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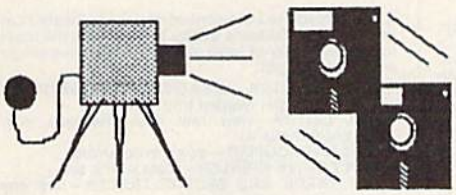
XH 20 DATA 0,0,0,127,192,0,127
      ,192
DE 30 DATA 0,126,0,0,127,0,0,1
      19
XX 40 DATA 128,0,115,192,0,113
      ,224,0
EK 50 DATA 0,240,0,0,120,0,0,6
      0
SP 60 DATA 0,0,30,0,0,15,0,0
FQ 70 DATA 7,128,0,3,192,0,1,2
      24
SK 80 DATA 0,0,240,0,0,120,0,0
MK 90 DATA 60,0,0,30,0,0,12,25
      5
KB 100 DATA 102,102,100,102,10
      2,100,102,102
BX 110 DATA 100,102,102,100,10
      2,102,100,102
RX 120 DATA 102,100,102,102,10
      0,102,102,100
FD 130 DATA 102,102,100,102,10
      2,100,102,102
PG 140 DATA 100,102,102,100,25
      5,254,100,238
SR 150 DATA 238,100,251,190,10
      0,238,238,100
PE 160 DATA 251,190,100,238,23
      8,100,251,190
JQ 170 DATA 100,238,238,100,25
      5,254,100,250
PX 180 POKE53280,0:POKE53281,0
KB 190 PRINTCHR$(142)"{CLR}":F
      ORD=1TO24:PRINT"{DOWN}"
      :NEXT
EA 200 PRINTSPC(5)"{WHT}UDI CO
      PYRIGHT 1987"
PP 210 PRINTSPC(5)"GCH COMPUTE
      ! PUBLICATIONS INC."
JX 220 PRINTSPC(5)"JFK ALL RIG
      HTS RESERVED"
JF 230 FORX=1TO15:PRINT"{UP}";
      :NEXT
GD 240 PRINTSPC(11)"{7 SPACES}SPRITE
      {SPACE}FLIP DEMO{OFF}"
AC 250 FORD=1TO2500:NEXT
JK 260 POKE53280,0:POKE53281,0
      :PRINT"{CLR}"
KA 270 PRINTCHR$(14)"{8 SPACES}":V=53
      248:FORS=832TO958:READX
      :POKES,X:NEXT
BA 280 POKE2040,14:POKE2041,13
GX 290 POKEV+21,7
SR 300 POKEV+40,5
MK 310 POKE53277,3:POKE53271,3
CX 320 POKEV,240:POKEV+1,202
PR 330 POKE53276,1:POKE53287,1
      :POKE53286,6:POKE53285,
      2
JH 340 POKEV+2,70:POKEV+3,202
PX 350 PRINTCHR$(14)"{CLR}{8 SPACES}
      {DOWN}"
MB 360 PRINT"{RIGHT}THIS MACHI
      NE LANGUAGE ROUTINE WIL
      L"
QG 370 PRINT"{DOWN}{RIGHT}MAXI
      MIZE THE POTENTIAL OF Y
      OUR SPRITE"
PE 380 PRINT"{DOWN}{RIGHT}DATA
      . IT ALLOWS YOU TO FLIP
       SPRITES"
AF 390 PRINT"{DOWN}{RIGHT}VERT
      ICALLY OR HORIZONTALLY.
       THEREFORE,"
AR 400 PRINT"{DOWN}{RIGHT}YOU
      {SPACE}CAN PRODUCE FOUR
       SPRITES FROM ONLY"
HQ 410 PRINT"{DOWN}{RIGHT}ONE
      {SPACE}DEFINITION. ANIM
      ATED SPRITES ARE"
GS 420 PRINT"{DOWN}{RIGHT}POSS
      IBLE WITHOUT USING VALU
      ABLE MEMORY."
HP 430 PRINT"{DOWN}{RVS}PRESS
      {SPACE}(H)ORIZONTAL OR
      {SPACE}(V)ERTICAL TO FL
      IP"
JB 440 GETA$:IFA$=""THEN440
PE 450 IFA$="H"THENPOKE781,13:
      SYS49152:POKE781,14:SYS
      49155:GOTO440
PH 460 IFA$="V"THENPOKE781,13:
      SYS49158:POKE781,14:SYS
      49158:GOTO440
PC 470 GOTO440
```

THEY'VE DONE IT AGAIN !



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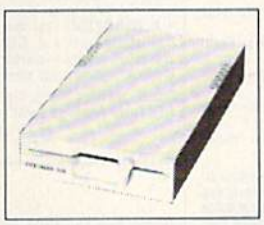

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ATTENTION C-128 OWNERS!

FEEL NEGLECTED? NO 80-COLUMN GRAPHICS SOFTWARE?

The Commodore C-128 is the most powerful and flexible 8-bit microcomputer yet released to the public. Unfortunately, there is little software available for its native 80-Column mode; and most of that is Productivity software using only the Text Character Display, not the true 80-Column Hi-Res Graphic Display which the machine is capable of producing.

Commodore originally intended the C-128's 8563 Video Display Chip to support 80-Columns only in Text mode, not Graphics. While standard C-128 Basic takes full advantage of the 40-Column graphics capability of the machine, there is almost nothing which allows the Basic programmer access to the 80-Column Graphics mode (Yes, there is an 80-Column Graphics mode!).

TIRED OF WAITING FOR YOUR 128 TO COME ALIVE? WAIT NO MORE. BASIC 8 IS HERE!

Patech Software is proud to introduce **Basic 8** with **Basic Paint**, the first C-128 software package specifically designed to unleash the hidden graphics potential of your Commodore C-128. Using a special wedge technique, **Basic 8** achieves performance rivaling that of 16-bit micros! Imagine your 128 producing resolution of 640 x 200 in monochrome and 640 x 192 in 16 colors without additional hardware! **Basic 8** provides the Basic programmer with the most powerful and productive graphics system ever developed for an 8-bit microcomputer!

A NEW HI-RES 3-D GRAPHICS LANGUAGE FOR THE C-128

Basic 8 adds over 50 Hi-Res graphics commands to Basic 7.0 and is completely compatible with its advanced non-graphic commands. You work in a true 3-Dimensional environment, controlling such parameters as perspective, viewing angles and the origin & depth of the view. Just select one of many graphics modes and draw 3-D lines, dots, circles, boxes, variable arcs and a multitude of complex solid shapes with a single command.

Switch easily between any of the 32 pre-defined graphic screens, scroll a screen, save and load multiple screens as brushes, define a logo, paint with exotic color patterns of your own design and print hard copy of your screens in various sizes and in color! We've even added commands for graphic cut & paste functions, brushes, windows and fonts along with ultra-sophisticated concepts like multidraw, grow, shearing, scaling and much, much, more.

More than a mere extension of Basic 7.0 – **Basic 8** is a total Development System which provides a whole new and exciting programming environment. Chances are that if your graphic imagination can see it, **Basic 8** will let you do it!.

UNHEARD-OF RESOLUTION AND STUNNING COLOR DISPLAYS ON YOUR C-128!

Pixel Resolution (screen size) and Color Resolution (color cell size) are determined by available Video RAM. The C-128 has 16K. This can be upgraded to the 64K of the C-128D.

The unexpanded C-128 produces a full 640 x 200 screen in monochrome and a maximum of 640 x 192 in color with an 8 x 16 dot cell. Increasing color resolution (smaller cell) decreases screen height. (Dot size remains the same throughout.) The most useful screen is 640 x 176 with an 8 x 8 cell. That's still pretty impressive! (The C-64 has 320 x 200 with the same cell.) If you use a 640 x 152, you can double the color resolution to 8 x 4. The resulting displays are absolutely stunning!

The 64K Video RAM allows the full 640 x 200 screen with an 8 x 2 cell (we doubled it again, this time with a full screen!) Several such screens can reside in Video RAM simultaneously, each with different resolutions. You can view one screen while working on another and create Virtual Screens (larger than the displayable 640 x 200) in Video RAM.

BASIC PAINT - AN 80-COLUMN COLOR DRAWING PROGRAM!

To demonstrate the power and versatility of this new graphics language, we have created **Basic Paint**, a flexible icon-based, mouse driven, 80-Column color drawing application with menus, fonts, brushes, patterns and requestors. **Basic Paint** is written in **Basic 8**, so that screens you create with it may be saved for use in your programs.

BASIC 8 GROWS WITH YOUR SYSTEM

Basic 8 supports all C-128 hardware upgrades and expanders. Each time you up-grade your system, **Basic 8** is ready and waiting with even more graphic power than ever!

Special printing features include color printing, 90° rotatable screens and variable dot density selection. The 64K Video RAM adds printing of entire Virtual Screens with the full page being dot addressable. Results are limited only by the capabilities of your printer.

★★ ALL THIS GRAPHICS POTENTIAL ★★ IS YOURS AT THE INTRODUCTORY PRICE OF $39.95

Includes: A 180-page Users Manual, the unprotected **Basic 8** Program Disk which creates **Basic 8** Work Disks (with complete Editor System), **Basic Paint** Work Disks and **Basic 8** RunTime Disks (lets you load and run your creations independent of **Basic 8** using the included WORKBENCH utility).

Requires: C-128 or 128D, 80-Column RGB Monitor & at least one Commodore compatible Disk Drive.

Supports: Expanded Video RAM (to 64K), Both RAM Expanders, The 1351 Proportional Mouse, Joysticks and most Dot Matrix Printers

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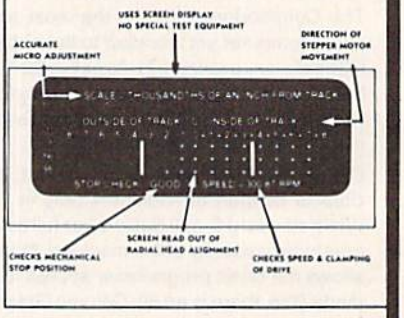
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See Reviews in: Run Special Issue #3, 1/87, p.83; Info #11, Aug/Sept 86, p.46 Midnite Gazette, April 1986, p. 19.

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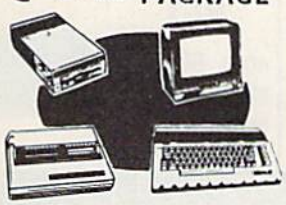

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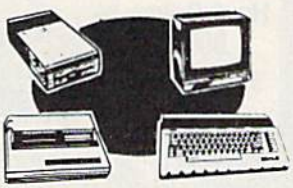

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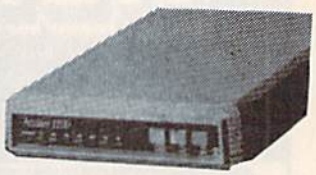

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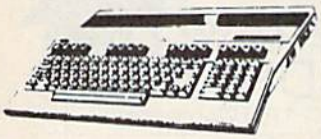

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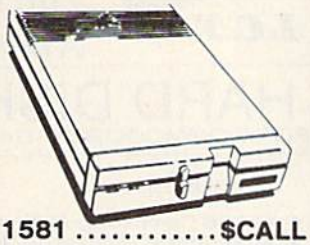

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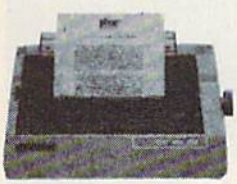

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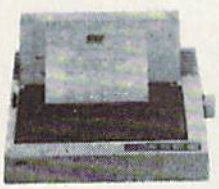

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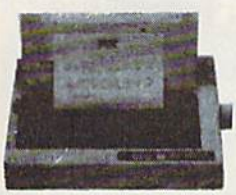

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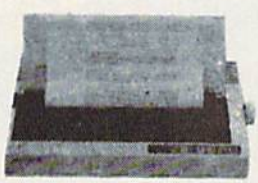

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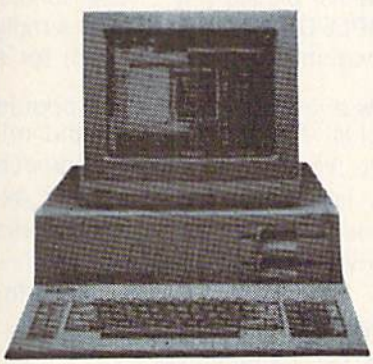

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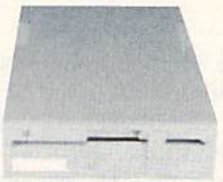

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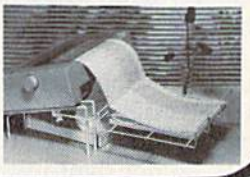

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COMPUTE!'s GAZETTE Author's Guide

Here are some suggestions which serve to improve the speed and accuracy of publication for prospective authors. COMPUTE!'s GAZETTE is primarily interested in new and timely articles on the Commodore 128, 64, Plus/4, and 16. We are much more concerned with the content of an article than with its style, but articles should as be clear and well-explained as possible.

The guidelines below will permit your good ideas and programs to be more easily edited and published:

1. The upper left corner of the first page should contain your name, address, telephone number, and the date of submission.

2. The following information should appear in the upper right corner of the first page: If your article is specifically directed to one model of computer, please state the model name. In addition, *please indicate the memory requirements of programs.*

3. The underlined title of the article should be placed about ⅔ of the way down the first page.

4. Following pages should be typed normally, except that in the upper right corner there should be an abbreviation of the title, your last name, and the page number—for example: Memory Map/Smith/2.

5. All lines within the text of the article must be double- or triple-spaced. A one-inch margin should be left at the right, left, top, and bottom of each page. No words should be divided at the ends of lines. And please do not right-justify. Leave the lines ragged.

6. Standard typing or computer paper should be used (no erasable, onionskin, or other thin paper), and typing should be on one side of the paper only (upper- and lowercase).

7. If you are submitting more than one article, send each one in a separate mailer with its own tape or disk.

8. Short programs (under 20 lines) can easily be included within the text. Longer programs should be separate listings. *It is essential that we have a copy of the program, recorded twice, on a tape or disk.* If your article was written with a word processor, we request that you include a copy of the text file on the tape or disk. If you include a copy of your article on disk, please save the article as plain text, without any special formatting characters or control codes. Most word processors provide an option for saving a document as plain ASCII text or in unformatted form. Please use high-quality 10- or 30-minute tapes with the program recorded on both sides. The tape or disk should be labeled with your name and the title of the article. Tapes are fairly sturdy, but disks need to be enclosed within plastic or cardboard mailers (available at photography, stationery, or computer supply stores). If possible, programs written in machine language or a compiled language should include source code (or an annotated disassembly if the program was written with a machine language monitor).

9. A good general rule is to spell out the numbers zero through ten in your article and write higher numbers as numerals (1024). The exceptions to this are: Figure 5, Table 3, TAB(4), and so on. Within ordinary text, however, the zero through ten should appear as words, not numbers. Also, symbols and abbreviations should not be used within text: Use *and* (not &), *reference* (not ref.), *through* (not thru).

10. For greater clarity, use all capitals when referring to keys (RETURN, CTRL, SHIFT), BASIC words (LIST, RND, GOTO), and the language BASIC. Headlines and subheads should, however, be initial caps only, and emphasized words are not capitalized. If you wish to emphasize, underline the word; then it will be italicized during typesetting.

11. Articles can be of any length—from a single-line routine to a multiple-issue series. The average article is about four to eight double-spaced, typed pages.

12. We do not consider articles which are submitted simultaneously to other publishers. If you wish to send an article to another magazine for consideration, please do not submit it to us.

13. COMPUTE!'s GAZETTE pays between $70 and $800 for published articles. In general, the rate reflects the length and quality of the article. Payment is made upon acceptance. Following submission (to Editorial Department, COMPUTE!'s GAZETTE, P.O. Box 5406, Greensboro, NC 27403), it will take from four to eight weeks for us to reply. If your work is accepted, you will be notified by a letter which will include a contract for you to sign and return. *Rejected manuscripts are returned to authors who enclose a self-addressed, stamped envelope.*

14. If your article is accepted and you subsequently make improvements to the program, please submit an entirely new tape or disk and a new copy of the article reflecting the update. We cannot easily make revisions to programs and articles. It is necessary that you send the revised version as if it were a new submission entirely, but be sure to indicate that your submission is a revised version by writing *Revision* on the envelope and the article.

15. COMPUTE!'s GAZETTE does not accept unsolicited product reviews. If you are interested in serving on our panel of reviewers, contact the Features Editor for details.

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How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the Commodore 128, 64, Plus/4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. All 64 programs run on the 128 in 64 mode. Be sure to read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We frequently publish two programs designed to make typing easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then on, erasing what was in memory. So be sure to *save a program before you run it.* If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 SPACES} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example, enter eight SHIFTed A's).

If a key is enclosed in special brackets, [ ], hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode.*

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + ↑ CRSR ↓	
{DOWN}	↑ CRSR ↓	
{LEFT}	SHIFT + ← CRSR →	
{RIGHT}	← CRSR →	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{ F1 }	f1	
{ F2 }	SHIFT + f1	
{ F3 }	f3	
{ F4 }	SHIFT + f3	
{ F5 }	f5	
{ F6 }	SHIFT + f5	
{ F7 }	f7	
{ F8 }	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↑	

For Commodore 64 Only

[1]	COMMODORE + 1	
[2]	COMMODORE + 2	
[3]	COMMODORE + 3	
[4]	COMMODORE + 4	
[5]	COMMODORE + 5	
[6]	COMMODORE + 6	
[7]	COMMODORE + 7	
[8]	COMMODORE + 8	

The Automatic Proofreader

Philip I. Nelson, Assistant Editor

"The Automatic Proofreader" helps you type in program listings for the 128, 64, Plus/4, and 16 and prevents nearly every kind of typing mistake.

Type in the Proofreader *exactly* as listed. Since the program can't check itself, type carefully to avoid mistakes. Don't omit any lines, even if they contain unfamiliar commands. After finishing, save a copy or two on disk or tape before running it. This is important because the Proofreader erases the BASIC portion of itself when you run it, leaving only the machine language portion in memory.

Next, type RUN and press RETURN. After announcing which computer it's running on, the Proofreader displays the message "Proofreader Active". Now you're ready to type in a BASIC program.

Every time you finish typing a line and press RETURN, the Proofreader displays a two-letter checksum in the upper-left corner of the screen. Compare this result with the two-letter checksum printed to the left of the line in the program listing. If the letters match, it's almost certain the line was typed correctly. If the letters don't match, check for your mistake and correct the line.

The Proofreader ignores spaces not enclosed in quotes, so you can omit or add spaces between keywords and still see a matching checksum. However, since spaces inside quotes are almost always significant, the Proofreader pays attention to them. For example, **10 PRINT"THIS IS BASIC"** will generate a different checksum than **10 PRINT"THIS ISBA SIC"**.

A common typing error is transposition—typing two successive characters in the wrong order, like PIRNT instead of PRINT or 64378 instead of 64738. The Proofreader is sensitive to the *position* of each character within the line and thus catches transposition errors.

The Proofreader does *not* accept keyword abbreviations (for example, ? instead of PRINT). If you prefer to use abbreviations, you can still check the line by LISTing it after typing it in, moving the cursor back to the line, and pressing RETURN. LISTing the line substitutes the full keyword for the abbreviation and allows the Proofreader to work properly. The same technique works for rechecking programs you've already typed in.

If you're using the Proofreader on the Commodore 128, Plus/4, or 16, *do not perform any GRAPHIC commands while the Proofreader is active.* When you perform a command like GRAPHIC 1, the computer moves everything at the start of BASIC program space—including the Proofreader—to another memory area, causing the Proofreader to crash. The same thing happens if you *run* any program with a GRAPHIC command while the Proofreader is in memory.

Though the Proofreader doesn't interfere with other BASIC operations, it's a good idea to disable it before running another program. However, the Proofreader is purposely difficult to dislodge: It's not affected by tape or disk operations, or by pressing RUN/STOP–RESTORE. The simplest way to disable it is to turn the computer off then on. A gentler method is to SYS to the computer's built-in reset routine (SYS 65341 for the 128, 64738 for the 64, and 65526 for the Plus/4 and 16). These reset routines erase any program in memory, so be sure to save the program you're typing in before entering the SYS command.

If you own a Commodore 64, you may already have wondered whether the Proofreader works with other programming utilities like "MetaBASIC." The answer is generally yes, *if you're using a 64 and activate the Proofreader after installing the other utility.* For example, first load and activate MetaBASIC, then load and run the Proofreader.

When using the Proofreader with another utility, you should disable *both* programs before running a BASIC program. While the Proofreader seems unaffected by most utilities, there's no way to promise that it will work with any and every combination of utilities you might want to use. The more utilities activated, the more fragile the system becomes.

The New Automatic Proofreader

```
10 VEC=PEEK(772)+256*PEEK(773)
   :LO=43:HI=44
20 PRINT "AUTOMATIC PROOFREADE
   R FOR ";:IF VEC=42364 THEN
   {SPACE}PRINT "C-64"
30 IF VEC=50556 THEN PRINT "VI
   C-20"
40 IF VEC=35158 THEN GRAPHIC C
   LR:PRINT "PLUS/4 & 16"
50 IF VEC=17165 THEN LO=45:HI=
   46:GRAPHIC CLR:PRINT"128"
60 SA=(PEEK(LO)+256*PEEK(HI))+
   6:ADR=SA
70 FOR J=0 TO 166:READ BYT:POK
   E ADR,BYT:ADR=ADR+1:CHK=CHK
   +BYT:NEXT
80 IF CHK<>20570 THEN PRINT "*
   ERROR* CHECK TYPING IN DATA
    STATEMENTS":END
90 FOR J=1 TO 5:READ RF,LF,HF:
   RS=SA+RF:HB=INT(RS/256):LB=
   RS-(256*HB)
100 CHK=CHK+RF+LF+HF:POKE SA+L
   F,LB:POKE SA+HF,HB:NEXT
110 IF CHK<>22054 THEN PRINT "
   *ERROR* RELOAD PROGRAM AND
   {SPACE}CHECK FINAL LINE":EN
   D
120 POKE SA+149,PEEK(772):POKE
    SA+150,PEEK(773)
130 IF VEC=17165 THEN POKE SA+
   14,22:POKE SA+18,23:POKESA+
   29,224:POKESA+139,224
140 PRINT CHR$(147);CHR$(17);"
   PROOFREADER ACTIVE":SYS SA
150 POKE HI,PEEK(HI)+1:POKE (P
   EEK(LO)+256*PEEK(HI))-1,0:N
   EW
160 DATA 120,169,73,141,4,3,16
   9,3,141,5,3
170 DATA 88,96,165,20,133,167,
   165,21,133,168,169
180 DATA 0,141,0,255,162,31,18
   1,199,157,227,3
190 DATA 202,16,248,169,19,32,
   210,255,169,18,32
200 DATA 210,255,160,0,132,180
   ,132,176,136,230,180
210 DATA 200,185,0,2,240,46,20
   1,34,208,8,72
220 DATA 165,176,73,255,133,17
   6,104,72,201,32,208
230 DATA 7,165,176,208,3,104,2
   08,226,104,166,180
240 DATA 24,165,167,121,0,2,13
   3,167,165,168,105
250 DATA 0,133,168,202,208,239
   ,240,202,165,167,69
260 DATA 168,72,41,15,168,185,
   211,3,32,210,255
270 DATA 104,74,74,74,74,168,1
   85,211,3,32,210
280 DATA 255,162,31,189,227,3,
   149,199,202,16,248
290 DATA 169,146,32,210,255,76
   ,86,137,65,66,67
300 DATA 68,69,70,71,72,74,75,
   77,80,81,82,83,88
310 DATA 13,2,7,167,31,32,151,
   116,117,151,128,129,167,136
   ,137
```

MLX Machine Language Entry Program For Commodore 64 and 128

Ottis R. Cowper, Technical Editor

"MLX" is a labor-saving utility that allows almost fail-safe entry of machine language programs. Included are versions for the Commodore 64 and 128.

Type in and save some copies of whichever version of MLX is appropriate for your computer (you'll want to use it to enter future ML programs from COMPUTE!'s GAZETTE). Program 1 is for the Commodore 64, and Program 2 is for the 128 (128 MLX can also be used to enter Commodore 64 ML programs for use in 64 mode). When you're ready to enter an ML program, load and run MLX. It asks you for a starting address and an ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing.

If you're unfamiliar with machine language, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But don't worry—even if you know nothing about ML or hex, you should have no trouble using MLX.

After you enter the starting and ending addresses, you'll be offered the option of clearing the workspace. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session, don't choose this option.

A functions menu will appear. The first option in the menu is ENTER DATA. If you're just starting to type in a program, pick this. Press the E key, and type the first number in the first line of the program listing. If you've already typed in part of a program, type the line number where you left off typing at the end of the previous session (be sure to load the partially completed program before you resume entry). In any case, make sure the address you enter corresponds to the address of a line in the listing you are entering. Otherwise, you'll be unable to enter the data correctly. If you pressed E by mistake, you can return to the command menu by pressing RETURN alone when asked for the address. (You can get back to the menu from most options by pressing RETURN with no other input.)

Entering A Listing

Once you're in Enter mode, MLX prints the address for each program line for you. You then type in all nine numbers on that line, beginning with the first two-digit number after the colon (:). Each line represents eight data bytes and a checksum. Although an MLX-format listing appears similar to the "hex dump" listings from a machine language monitor program, the extra checksum number on the end allows MLX to check your typing. (Commodore 128 users *can* enter the data from an MLX listing using the built-in monitor if the rightmost column of data is omitted, but we recommend against it. It's much easier to let MLX do the proofreading and error checking for you.)

When you enter a line, MLX recalculates the checksum from the eight bytes and the address and compares this value to the number from the ninth column. If the values match, you'll hear a bell tone, the data will be added to the workspace area, and the prompt for the next line of data will appear. But if MLX detects a typing error, you'll hear a low buzz and see an error message. The line will then be redisplayed for editing.

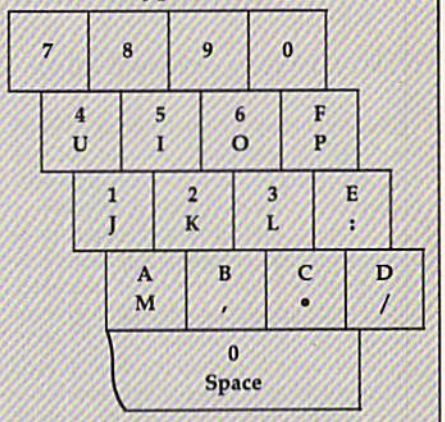
Invalid Characters Banned

Only a few keys are active while you're entering data, so you may have to unlearn some habits. You *do not* type spaces between the columns; MLX automatically inserts these for you. You *do not* press RETURN after typing the last number in a line; MLX automatically enters and checks the line after you type the last digit.

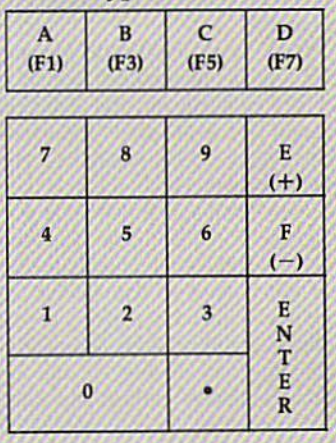
Only the numerals 0–9 and the letters A–F can be typed in. If you press any other key (with some exceptions noted below), you'll hear a warning buzz. To simplify typing, 128 MLX redefines the function keys and + and − keys on the numeric keypad so that you can enter data one-handed. (The 64 version incorporates the keypad modification from the March 1986 "Bug-Swatter" column, lines 485–487.) In either case, the keypad is active only while entering data. Addresses must be entered with the normal letter and number keys. The figures above show the keypad configurations for each version.

MLX checks for transposed characters. If you're supposed to type in A0 and instead enter 0A, MLX will catch your mistake. There is one error that can slip past MLX: Because of the checksum formula used, MLX won't notice if you accidentally type FF in place of 00, and vice versa. And there's a very slim chance that you could garble a line and still end up with a combination of characters that adds up to the proper checksum. However, these mistakes should not occur if you take reasonable care while entering data.

64 MLX Keypad



128 MLX Keypad



Editing Features

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line really badly, press CLR/HOME to start the line over. The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line

number prompt.

More editing features are available when correcting lines in which MLX has detected an error. To make corrections in a line that MLX has redisplayed for editing, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. The cursor left and right keys provide the normal cursor controls. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Display Data

The second menu choice, DISPLAY DATA, examines memory and shows the contents in the same format as the program listing (including the checksum). When you press D, MLX asks you for a starting address. Be sure that the starting address you give corresponds to a line number in the listing. Otherwise, the checksum display will be meaningless. MLX displays program lines until it reaches the end of the program, at which point the menu is redisplayed. You can pause the display by pressing the space bar. (MLX finishes printing the current line before halting.) Press space again to restart the display. To break out of the display and get back to the menu before the ending address is reached, press RETURN.

Other Menu Options

Two more menu selections let you save programs and load them back into the computer. These are SAVE FILE and LOAD FILE; their operation is quite straightforward. When you press S or L, MLX asks you for the filename. You'll then be asked to press either D or T to select disk or tape.

You'll notice the disk drive starting and stopping several times during a load or save (save only for the 128 version). Don't panic; this is normal behavior. MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands (128 MLX makes use of BLOAD). Disk users should also note that the drive prefix 0: is automatically added to the filename (line 750 in 64 MLX), so this should *not* be included when entering the name. This also precludes the use of @ for Save-with-Replace, so remember to give each version you save a different name. The 128 version makes up for this by giving you the option of scratching the existing file if you want to reuse a filename.

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

MLX reports the standard disk or tape error messages if any problems are detected during the save or load. (Tape users should bear in mind that Commodore computers are never able to detect errors during a save to tape.) MLX also has three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're trying to load does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're trying to load ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're trying to load extends beyond the ending address you specified when you started MLX. If you see one of these messages and feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct starting and ending addresses.

The 128 version also has a CATALOG DISK option so you can view the contents of the disk directory before saving or loading.

The QUIT menu option has the obvious effect—it stops MLX and enters BASIC. The RUN/STOP key is disabled, so the Q option lets you exit the program without turning off the computer. (Of course, RUN/STOP-RESTORE also gets you out.) You'll be asked for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. The instructions for loading and using the finished product vary from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk (DLOAD *"filename"* on the 128) or LOAD *"filename"*,1 for tape, and then RUN. Such programs will usually have a starting address of 0801 for the 64 or 1C01 for the 128. Other programs must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk (BLOAD *"filename"* on the 128) or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000. In either case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

An Ounce Of Prevention

By the time you finish typing in the data for a long ML program, you may have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type the new MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to ensure that you can recall your work from disk or tape. Don't let a simple typing error in the new MLX cost you several nights of hard work.

Program 1: MLX For Commodore 64

```
SS 10 REM VERSION 1.1: LINES 8
      30,950 MODIFIED, LINES 4
      85-487 ADDED
EK 100 POKE 56,50:CLR:DIM IN$,
      I,J,A,B,A$,B$,A(7),N$
DM 110 C4=48:C6=16:C7=7:Z2=2:Z
      4=254:Z5=255:Z6=256:Z7=
      127
CJ 120 FA=PEEK(45)+Z6*PEEK(46)
      :BS=PEEK(55)+Z6*PEEK(56
      ):H$="0123456789ABCDEF"
SB 130 R$=CHR$(13):L$="{LEFT}"
      :S$=" ":D$=CHR$(20):Z$=
      CHR$(0):T$="{13 RIGHT}"
CQ 140 SD=54272:FOR I=SD TO SD
      +23:POKE I,0:NEXT:POKE
      {SPACE}SD+24,15:POKE 78
      8,52
FC 150 PRINT"{CLR}"CHR$(142)CH
      R$(8):POKE 53280,15:POK
      E 53281,15
EJ 160 PRINT T$" {RED}{RVS}
      {2 SPACES}{8 @}
      {2 SPACES}"SPC(28)"
      {2 SPACES}{OFF}{BLU} ML
      X II {RED}{RVS}
      {2 SPACES}"SPC(28)"
      {12 SPACES}{BLU}"
FR 170 PRINT"{3 DOWN}
      {3 SPACES}COMPUTE!'S MA
      CHINE LANGUAGE EDITOR
      {3 DOWN}"
JB 180 PRINT"{BLK}STARTING ADD
```

```
      RESS{4 SPACES}";:GOSUB300:SA=A
      D:GOSUB1040:IF F THEN18
      Ø
GF 190 PRINT"{BLK}{2 SPACES}EN
      DING ADDRESS{4 SPACES}";:GOSUB
      300:EA=AD:GOSUB1030:IF
      {SPACE}F THEN190
KR 200 INPUT"{3 DOWN}{BLK}CLEA
      R WORKSPACE [Y/N]{4 SPACES}";A
      $:IF LEFT$(A$,1)<>"Y"TH
      EN220
PG 210 PRINT"{2 DOWN}{BLU}WORK
      ING...";:FORI=BS TO BS+
      EA-SA+7:POKE I,Ø:NEXT:P
      RINT"DONE"
DR 220 PRINTTAB(10)"{2 DOWN}
      {BLK}{RVS} MLX COMMAND
      {SPACE}MENU {DOWN}{4 SPACES}":
      PRINT T$"{RVS}E{OFF}NTE
      R DATA"
BD 230 PRINT T$"{RVS}D{OFF}ISP
      LAY DATA":PRINT T$"
      {RVS}L{OFF}OAD FILE"
JS 240 PRINT T$"{RVS}S{OFF}AVE
       FILE":PRINT T$"{RVS}Q
      {OFF}UIT{2 DOWN}{BLK}"
JH 250 GET A$:IF A$=N$ THEN250
HK 260 A=Ø:FOR I=1 TO 5:IF A$=
      MID$("EDLSQ",I,1)THEN A
      =I:I=5
FD 270 NEXT:ON A GOTO420,610,6
      90,700,280:GOSUB1060:GO
      TO250
EJ 280 PRINT"{RVS} QUIT ":INPU
      T"{DOWN}{4 SPACES}ARE YOU SURE
       [Y/N]";A$:IF LEFT$(A$,
      1)<>"Y"THEN220
EM 290 POKE SD+24,Ø:END
JX 300 IN$=N$:AD=Ø:INPUTIN$:IF
      LEN(IN$)<>4THENRETURN
KF 310 B$=IN$:GOSUB320:AD=A:B$
      =MID$(IN$,3):GOSUB320:A
      D=AD*256+A:RETURN
PP 320 A=Ø:FOR J=1 TO 2:A$=MID
      $(B$,J,1):B=ASC(A$)-C4+
      (A$>"@")*C7:A=A*C6+B
JA 330 IF B<Ø OR B>15 THEN AD=
      Ø:A=-1:J=2
GX 340 NEXT:RETURN
CH 350 B=INT(A/C6):PRINT MID$(
      H$,B+1,1);:B=A-B*C6:PRI
      NT MID$(H$,B+1,1);:RETU
      RN
RR 360 A=INT(AD/Z6):GOSUB350:A
      =AD-A*Z6:GOSUB350:PRINT
      ":";
BE 370 CK=INT(AD/Z6):CK=AD-Z4*
      CK+Z5*(CK>Z7):GOTO390
PX 380 CK=CK*Z2+Z5*(CK>Z7)+A
JC 390 CK=CK+Z5*(CK>Z5):RETURN
QS 400 PRINT"{DOWN}STARTING AT
      {4 SPACES}";:GOSUB300:IF IN$<>
      N$ THEN GOSUB1030:IF F
      {SPACE}THEN400
EX 410 RETURN
HD 420 PRINT"{RVS} ENTER DATA
      {SPACE}":GOSUB400:IF IN
      $=N$ THEN220
JK 430 OPEN3,3:PRINT
SK 440 POKE198,Ø:GOSUB360:IF F
       THEN PRINT IN$:PRINT"
      {UP}{5 RIGHT}";
GC 450 FOR I=Ø TO 24 STEP 3:B$
      =S$:FOR J=1 TO 2:IF F T
      HEN B$=MID$(IN$,I+J,1)
HA 460 PRINT"{RVS}"B$L$;:IF I<
      24THEN PRINT"{OFF}";
HD 470 GET A$:IF A$=N$ THEN470
FK 480 IF(A$>"/"ANDA$<":")OR(A
      $>"@"ANDA$<"G")THEN540
GS 485 A=-(A$="M")-2*(A$=",")-
      3*(A$=".")-4*(A$="/")-5
      *(A$="J")-6*(A$="K")
FX 486 A=A-7*(A$="L")-8*(A$=";
      ")-9*(A$="U")-10*(A$="I
      ")-11*(A$="O")-12*(A$="
      P")
CM 487 A=A-13*(A$=S$):IF A THE
      N A$=MID$("ABCD123E456F
      Ø",A,1):GOTO 540
MP 490 IF A$=R$ AND((I=Ø)AND(J
      =1)OR F)THEN PRINT B$;:
      J=2:NEXT:I=24:GOTO550
KC 500 IF A$="{HOME}" THEN PRI
      NT B$:J=2:NEXT:I=24:NEX
      T:F=Ø:GOTO440
MX 510 IF(A$="{RIGHT}")ANDF TH
      ENPRINT B$L$;:GOTO540
GK 520 IF A$<>L$ AND A$<>D$ OR
      ((I=Ø)AND(J=1))THEN GOS
      UB1060:GOTO470
HG 530 A$=L$+S$+L$:PRINT B$L$;
      :J=2-J:IF J THEN PRINT
      {SPACE}L$;:I=I-3
QS 540 PRINT A$;:NEXT J:PRINT
      {SPACE}S$;
PM 550 NEXT I:PRINT:PRINT"{UP}
      {5 RIGHT}";:INPUT#3,IN$
      :IF IN$=N$ THEN CLOSE3:
      GOTO220
QC 560 FOR I=1 TO 25 STEP3:B$=
      MID$(IN$,I):GOSUB320:IF
       I<25 THEN GOSUB380:A(I
      /3)=A
PK 570 NEXT:IF A<>CK THEN GOSU
      B1060:PRINT"{BLK}{RVS}
      {SPACE}ERROR: REENTER L
      INE {4 SPACES}":F=1:GOTO440
HJ 580 GOSUB1080:B=BS+AD-SA:FO
      R I=Ø TO 7:POKE B+I,A(I
      ):NEXT
QQ 590 AD=AD+8:IF AD>EA THEN C
      LOSE3:PRINT"{DOWN}{BLU}
      ** END OF ENTRY **{BLK}
      {2 DOWN}":GOTO700
GQ 600 F=Ø:GOTO440
QA 610 PRINT"{CLR}{DOWN}{RVS}
      {SPACE}DISPLAY DATA ":G
      OSUB400:IF IN$=N$ THEN2
      20
RJ 620 PRINT"{DOWN}{BLU}PRESS:
       {RVS}SPACE{OFF} TO PAU
      SE, {RVS}RETURN{OFF} TO
       BREAK{4 SPACES}{DOWN}"
KS 630 GOSUB360:B=BS+AD-SA:FOR
      I=BTO B+7:A=PEEK(I):GOS
      UB350:GOSUB380:PRINT S$
      ;
CC 640 NEXT:PRINT"{RVS}";:A=CK
      :GOSUB350:PRINT
KH 650 F=1:AD=AD+8:IF AD>EA TH
      ENPRINT"{DOWN}{BLU}** E
      ND OF DATA **":GOTO220
KC 660 GET A$:IF A$=R$ THEN GO
      SUB1080:GOTO220
EQ 670 IF A$=S$ THEN F=F+1:GOS
      UB1080
AD 680 ONFGOTO630,660,630
CM 690 PRINT"{DOWN}{RVS} LOAD
      {SPACE}DATA ":OP=1:GOTO
      710
PC 700 PRINT"{DOWN}{RVS} SAVE
      {SPACE}FILE ":OP=Ø
RX 710 IN$=N$:INPUT"{DOWN}FILE
      NAME{4 SPACES}";IN$:IF IN$=N$
      {SPACE}THEN220
PR 720 F=Ø:PRINT"{DOWN}{BLK}
      {RVS}T{OFF}APE OR {RVS}
      D{OFF}ISK: {4 SPACES}";
FP 730 GET A$:IF A$="T"THEN PR
      INT"T{DOWN}":GOTO880
HQ 740 IF A$<>"D"THEN730
HH 750 PRINT"D{DOWN}":OPEN15,8
      ,15,"I0:":B=EA-SA:IN$="
      Ø:"+IN$:IF OP THEN810
SQ 760 OPEN 1,8,8,IN$+",P,W":G
      OSUB860:IF A THEN220
FJ 770 AH=INT(SA/256):AL=SA-(A
      H*256):PRINT#1,CHR$(AL)
      ;CHR$(AH);
PE 780 FOR I=Ø TO B:PRINT#1,CH
      R$(PEEK(BS+I));:IF ST T
      HEN800
FC 790 NEXT:CLOSE1:CLOSE15:GOT
      O940
GS 800 GOSUB1060:PRINT"{DOWN}
      {BLK}ERROR DURING SAVE:
      {4 SPACES}":GOSUB860:GOTO220
MA 810 OPEN 1,8,8,IN$+",P,R":G
      OSUB860:IF A THEN220
GE 820 GET#1,A$,B$:AD=ASC(A$+Z
      $)+256*ASC(B$+Z$):IF AD
      <>SA THEN F=1:GOTO850
RX 830 FOR I=Ø TO B:GET#1,A$:P
      OKE BS+I,ASC(A$+Z$):IF(
      I<>B)AND ST THEN F=2:AD
      =I:I=B
FA 840 NEXT:IF ST<>64 THEN F=3
FQ 850 CLOSE1:CLOSE15:ON ABS(F
      >Ø)+1 GOTO960,970
SA 860 INPUT#15,A,A$:IF A THEN
       CLOSE1:CLOSE15:GOSUB10
      60:PRINT"{RVS}ERROR: "A
      $
GQ 870 RETURN
EJ 880 POKE183,PEEK(FA+2):POKE
      187,PEEK(FA+3):POKE188,
      PEEK(FA+4):IFOP=ØTHEN92
      Ø
HJ 890 SYS 63466:IF(PEEK(783)A
      ND1)THEN GOSUB1060:PRIN
      T"{DOWN}{RVS} FILE NOT
      {SPACE}FOUND ":GOTO690
CS 900 AD=PEEK(829)+256*PEEK(8
      30):IF AD<>SA THEN F=1:
      GOTO970
SC 910 A=PEEK(831)+256*PEEK(83
      2)-1:F=F-2*(A<EA)-3*(A>
      EA):AD=A-AD:GOTO930
KM 920 A=SA:B=EA+1:GOSUB1010:P
      OKE780,3:SYS 63338
JF 930 A=BS:B=BS+(EA-SA)+1:GOS
      UB1010:ON OP GOTO950:SY
      S 63591
AE 940 GOSUB1080:PRINT"{BLU}**
       SAVE COMPLETED **":GOT
      O220
XP 950 POKE147,Ø:SYS 63562:IF
      {SPACE}ST>Ø THEN970
FR 960 GOSUB1080:PRINT"{BLU}**
       LOAD COMPLETED **":GOT
      O220
DP 970 GOSUB1060:PRINT"{BLK}
      {RVS}ERROR DURING LOAD:
      {DOWN}{4 SPACES}":ON F GOSUB98
      Ø,990,1000:GOTO220
PP 980 PRINT"INCORRECT STARTIN
      G ADDRESS (";:GOSUB360:
      PRINT")":RETURN
GR 990 PRINT"LOAD ENDED AT ";:
      AD=SA+AD:GOSUB360:PRINT
       D$:RETURN
FD 1000 PRINT"TRUNCATED AT END
       ING ADDRESS":RETURN
RX 1010 AH=INT(A/256):AL=A-(AH
      *256):POKE193,AL:POKE1
      94,AH
FF 1020 AH=INT(B/256):AL=B-(AH
      *256):POKE174,AL:POKE1
      75,AH:RETURN
FX 1030 IF AD<SA OR AD>EA THEN
       1050
HA 1040 IF(AD>511 AND AD<40960
```

```
        )OR(AD>49151 AND AD<53
        248)THEN GOSUB1080:F=0
        :RETURN
HC 1050 GOSUB1060:PRINT"{RVS}
        {SPACE}INVALID ADDRESS
        {DOWN}{BLK}":F=1:RETU
        RN
AR 1060 POKE SD+5,31:POKE SD+6
        ,208:POKE SD,240:POKE
        {SPACE}SD+1,4:POKE SD+
        4,33
DX 1070 FOR S=1 TO 100:NEXT:GO
        TO1090
PF 1080 POKE SD+5,8:POKE SD+6,
        240:POKE SD,0:POKE SD+
        1,90:POKE SD+4,17
AC 1090 FOR S=1 TO 100:NEXT:PO
        KE SD+4,0:POKE SD,0:PO
        KE SD+1,0:RETURN
```

Program 2: MLX For Commodore 128

```
AE 100 TRAP 960:POKE 4627,128:
       DIM NL$,A(7)
XP 110 Z2=2:Z4=254:Z5=255:Z6=2
       56:Z7=127:BS=256*PEEK(4
       627):EA=65280
FB 120 BE$=CHR$(7):RT$=CHR$(13
       ):DL$=CHR$(20):SP$=CHR$
       (32):LF$=CHR$(157)
KE 130 DEF FNHB(A)=INT(A/256):
       DEF FNLB(A)=A-FNHB(A)*2
       56:DEF FNAD(A)=PEEK(A)+
       256*PEEK(A+1)
JB 140 KEY 1,"A":KEY 3,"B":KEY
        5,"C":KEY 7,"D":VOL 15
       :IF RGR(0)=5 THEN FAST
FJ 150 PRINT"{CLR}"CHR$(142);C
       HR$(8):COLOR 0,15:COLOR
        4,15:COLOR 6,15
GQ 160 PRINT TAB(12)"{RED}
       {RVS}{2 SPACES}[9 @]
       {2 SPACES}"RT$;TAB(12)"
       {RVS}{2 SPACES}{OFF}
       {BLU} 128 MLX {RED}
       {RVS}{2 SPACES}"RT$;TAB
       (12)"{RVS}{13 SPACES}
       {BLU}"
FE 170 PRINT"{2 DOWN}
       {3 SPACES}COMPUTE!'S MA
       CHINE LANGUAGE EDITOR
       {2 DOWN}"
DK 180 PRINT"{BLK}STARTING ADD
       RESS[43]";:GOSUB 260:IF
       {SPACE}AD THEN SA=AD:EL
       SE 180
FH 190 PRINT"{BLK}{2 SPACES}EN
       DING ADDRESS[43]";:GOSUB
        260:IF AD THEN EA=AD:E
       LSE 190
MF 200 PRINT"{DOWN}{BLK}CLEAR
       {SPACE}WORKSPACE [Y/N]?
       [43]":GETKEY A$:IF A$<>"
       Y" THEN 220
QH 210 PRINT"{DOWN}{BLU}WORKIN
       G...";:BANK 0:FOR A=BS
       {SPACE}TO BS+(EA-SA)+7:
       POKE A,0:NEXT A:PRINT"D
       ONE"
DC 220 PRINT TAB(10)"{DOWN}
       {BLK}{RVS} MLX COMMAND
       {SPACE}MENU [43]{DOWN}":
       PRINT TAB(13)"{RVS}E
       {OFF}NTER DATA"RT$;TAB(
       13)"{RVS}D{OFF}ISPLAY D
       ATA"RT$;TAB(13)"{RVS}L
       {OFF}OAD FILE"
HB 230 PRINT TAB(13)"{RVS}S
       {OFF}AVE FILE"RT$;TAB(1
       3)"{RVS}C{OFF}ATALOG DI
       SK"RT$;TAB(13)"{RVS}Q
       {OFF}UIT{DOWN}{BLK}"
AP 240 GETKEY A$:A=INSTR("EDLS
       CQ",A$):ON A GOTO 340,5
       50,640,650,930,940:GOSU
       B 950:GOTO 240
SX 250 PRINT"STARTING AT";:GOS
       UB 260:IF(AD<>0)OR(A$=N
       L$)THEN RETURN:ELSE 250
BG 260 A$=NL$:INPUT A$:IF LEN(
       A$)=4 THEN AD=DEC(A$)
PP 270 IF AD=0 THEN BEGIN:IF A
       $<>NL$ THEN 300:ELSE RE
       TURN:BEND
MA 280 IF AD<SA OR AD>EA THEN
       {SPACE}300
PM 290 IF AD>511 AND AD<65280
       {SPACE}THEN PRINT BE$;:
       RETURN
SQ 300 GOSUB 950:PRINT"{RVS} I
       NVALID ADDRESS {DOWN}
       {BLK}":AD=0:RETURN
RD 310 CK=FNHB(AD):CK=AD-Z4*CK
       +Z5*(CK>Z7):GOTO 330
DD 320 CK=CK*Z2+Z5*(CK>Z7)+A
AH 330 CK=CK+Z5*(CK>Z5):RETURN
QD 340 PRINT BE$;"{RVS} ENTER
       {SPACE}DATA ":GOSUB 250
       :IF A$=NL$ THEN 220
JA 350 BANK 0:PRINT:F=0:OPEN 3
       ,3
BR 360 GOSUB 310:PRINT HEX$(AD
       )+":";:IF F THEN PRINT
       {SPACE}L$:PRINT"{UP}
       {5 RIGHT}";
QA 370 FOR I=0 TO 24 STEP 3:B$
       =SP$:FOR J=1 TO 2:IF F
       {SPACE}THEN B$=MID$(L$,
       I+J,1)
PS 380 PRINT"{RVS}"B$+LF$;:IF
       {SPACE}I<24 THEN PRINT"
       {OFF}";
RC 390 GETKEY A$:IF (A$>"/" AN
       D A$<":") OR(A$>"@" AND
        A$<"G") THEN 470
AC 400 IF A$="+" THEN A$="E":G
       OTO 470
QB 410 IF A$="-" THEN A$="F":G
       OTO 470
FB 420 IF A$=RT$ AND ((I=0) AN
       D (J=1) OR F) THEN PRIN
       T B$;:J=2:NEXT:I=24:GOT
       O 480
RD 430 IF A$="{HOME}" THEN PRI
       NT B$:J=2:NEXT:I=24:NEX
       T:F=0:GOTO 360
XB 440 IF (A$="{RIGHT}") AND F
        THEN PRINT B$+LF$;:GOT
       O 470
JP 450 IF A$<>LF$ AND A$<>DL$
       {SPACE}OR ((I=0) AND (J
       =1)) THEN GOSUB 950:GOT
       O 390
PS 460 A$=LF$+SP$+LF$:PRINT B$
       +LF$;:J=2-J:IF J THEN P
       RINT LF$;:I=I-3
GB 470 PRINT A$;:NEXT J:PRINT
       {SPACE}SP$;
HA 480 NEXT I:PRINT:PRINT"{UP}
       {5 RIGHT}";:L$="
       {27 SPACES}"
DP 490 FOR I=1 TO 25 STEP 3:GE
       T#3,A$,B$:IF A$=SP$ THE
       N I=25:NEXT:CLOSE 3:GOT
       O 220
BA 500 A$=A$+B$:A=DEC(A$):MID$
       (L$,I,2)=A$:IF I<25 THE
       N GOSUB 320:A(I/3)=A:GE
       T#3,A$
AR 510 NEXT I:IF A<>CK THEN GO
       SUB 950:PRINT:PRINT"
       {RVS} ERROR: REENTER LI
       NE ":F=1:GOTO 360
DX 520 PRINT BE$;B=BS+AD-SA:FO
       R I=0 TO 7:POKE B+I,A(I
       ):NEXT I
XB 530 F=0:AD=AD+8:IF AD<=EA T
       HEN 360
CA 540 CLOSE 3:PRINT"{DOWN}
       {BLU}** END OF ENTRY **
       {BLK}{2 DOWN}":GOTO 650
MC 550 PRINT BE$;"{CLR}{DOWN}
       {RVS} DISPLAY DATA ":GO
       SUB 250:IF A$=NL$ THEN
       {SPACE}220
JF 560 BANK 0:PRINT"{DOWN}
       {BLU}PRESS: {RVS}SPACE
       {OFF} TO PAUSE, {RVS}RE
       TURN{OFF} TO BREAK[43]
       {DOWN}"
XA 570 PRINT HEX$(AD)+":";:GOS
       UB 310:B=BS+AD-SA
DJ 580 FOR I=B TO B+7:A=PEEK(I
       ):PRINT RIGHT$(HEX$(A),
       2);SP$;:GOSUB 320:NEXT
       {SPACE}I
XB 590 PRINT"{RVS}";RIGHT$(HEX
       $(CK),2)
GR 600 F=1:AD=AD+8:IF AD>EA TH
       EN PRINT"{BLU}** END OF
        DATA **":GOTO 220
EB 610 GET A$:IF A$=RT$ THEN P
       RINT BE$:GOTO 220
QK 620 IF A$=SP$ THEN F=F+1:PR
       INT BE$;
XS 630 ON F GOTO 570,610,570
RF 640 PRINT BE$"{DOWN}{RVS} L
       OAD DATA ":OP=1:GOTO 66
       0
BP 650 PRINT BE$"{DOWN}{RVS} S
       AVE FILE ":OP=0
DM 660 F=0:F$=NL$:INPUT"FILENA
       ME[43]";F$:IF F$=NL$ THE
       N 220
RF 670 PRINT"{DOWN}{BLK}{RVS}T
       {OFF}APE OR {RVS}D{OFF}
       ISK: [43]";
SQ 680 GETKEY A$:IF A$="T" THE
       N 850:ELSE IF A$<>"D" T
       HEN 680
SP 690 PRINT"DISK{DOWN}":IF OP
        THEN 760
EG 700 DOPEN#1,(F$+",P"),W:IF
       {SPACE}DS THEN A$=DS$:G
       OTO 740
JH 710 BANK 0:POKE BS-2,FNLB(S
       A):POKE BS-1,FNHB(SA):P
       RINT"SAVING ";F$:PRINT
MC 720 FOR A=BS-2 TO BS+EA-SA:
       PRINT#1,CHR$(PEEK(A));:
       IF ST THEN A$="DISK WRI
       TE ERROR":GOTO 750
GC 730 NEXT A:CLOSE 1:PRINT"
       {BLU}** SAVE COMPLETED
       {SPACE}WITHOUT ERRORS *
       *":GOTO 220
RA 740 IF DS=63 THEN BEGIN:CLO
       SE 1:INPUT"{BLK}REPLACE
        EXISTING FILE [Y/N][43]
       ";A$:IF A$="Y" THEN SCR
       ATCH(F$):PRINT:GOTO 700
       :ELSE PRINT"{BLK}":GOTO
        660:BEND
GA 750 CLOSE 1:GOSUB 950:PRINT
       "{BLK}{RVS} ERROR DURIN
       G SAVE: [43]":PRINT A$:G
       OTO 220
FD 760 DOPEN#1,(F$+",P"):IF DS
        THEN A$=DS$:F=4:CLOSE
       {SPACE}1:GOTO 790
```

```
PX 770 GET#1,A$,B$:CLOSE 1:AD=
       ASC(A$)+256*ASC(B$):IF
       {SPACE}AD<>SA THEN F=1:
       GOTO 790
KB 780 PRINT"LOADING ";F$:PRIN
       T:BLOAD(F$),B0,P(BS):AD
       =SA+FNAD(174)-BS-1:F=-2
       *(AD<EA)-3*(AD>EA)
RQ 790 IF F THEN 800:ELSE PRIN
       T"{BLU}** LOAD COMPLETE
       D WITHOUT ERRORS **":GO
       TO 220
ER 800 GOSUB 950:PRINT"{BLK}
       {RVS} ERROR DURING LOAD
       : {4$}":ON F GOSUB 810,8
       20,830,840:GOTO220
QJ 810 PRINT"INCORRECT STARTIN
       G ADDRESS (";HEX$(AD);"
       )":RETURN
DP 820 PRINT"LOAD ENDED AT ";H
       EX$(AD):RETURN
EB 830 PRINT"TRUNCATED AT ENDI
       NG ADDRESS ("HEX$(EA)")
       ":RETURN
FP 840 PRINT"DISK ERROR ";A$:R
       ETURN
KS 850 PRINT"TAPE":AD=POINTER(
       F$):BANK 1:A=PEEK(AD):A
       L=PEEK(AD+1):AH=PEEK(AD
       +2)
XX 860 BANK 15:SYS DEC("FF68")
       ,0,1:SYS DEC("FFBA"),1,
       1,0:SYS DEC("FFBD"),A,A
       L,AH:SYS DEC("FF90"),12
       8:IF OP THEN 890
FG 870 PRINT:A=SA:B=EA+1:GOSUB
        920:SYS DEC("E919"),3:
       PRINT"SAVING ";F$
AB 880 A=BS:B=BS+(EA-SA)+1:GOS
       UB 920:SYS DEC("EA18"):
       PRINT"{DOWN}{BLU}** TAP
       E SAVE COMPLETED **":GO
       TO 220
CP 890 SYS DEC("E99A"):PRINT:I
       F PEEK(2816)=5 THEN GOS
       UB 950:PRINT"{DOWN}
       {BLK}{RVS} FILE NOT FOU
       ND ":GOTO 220
GQ 900 PRINT"LOADING ...{DOWN}
       ":AD=FNAD(2817):IF AD<>
       SA THEN F=1:GOTO 800:EL
       SE AD=FNAD(2819)-1:F=-2
       *(AD<EA)-3*(AD>EA)
JD 910 A=BS:B=BS+(EA-SA)+1:GOS
       UB 920:SYS DEC("E9FB"):
       IF ST>0 THEN 800:ELSE 7
       90
XB 920 POKE193,FNLB(A):POKE194
       ,FNHB(A):POKE 174,FNLB(
       B):POKE 175,FNHB(B):RET
       URN
CP 930 CATALOG:PRINT"{DOWN}
       {BLU}** PRESS ANY KEY F
       OR MENU **":GETKEY A$:G
       OTO 220
MM 940 PRINT BE$"{RVS} QUIT
       {4$}";RT$;"ARE YOU SURE
       {SPACE}[Y/N]?":GETKEY A
       $:IF A$<>"Y" THEN 220:E
       LSE PRINT"{CLR}":BANK 1
       5:END
JE 950 SOUND 1,500,10:RETURN
AF 960 IF ER=14 AND EL=260 THE
       N RESUME 300
MK 970 IF ER=14 AND EL=500 THE
       N RESUME NEXT
KJ 980 IF ER=4 AND EL=780 THEN
        F=4:A$=DS$:RESUME 800
DQ 990 IF ER=30 THEN RESUME:EL
       SE PRINT ERR$(ER);" ERR
       OR IN LINE";EL
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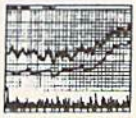

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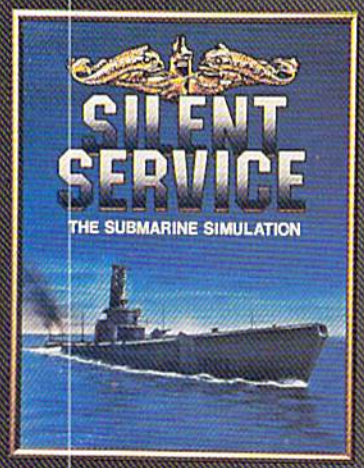

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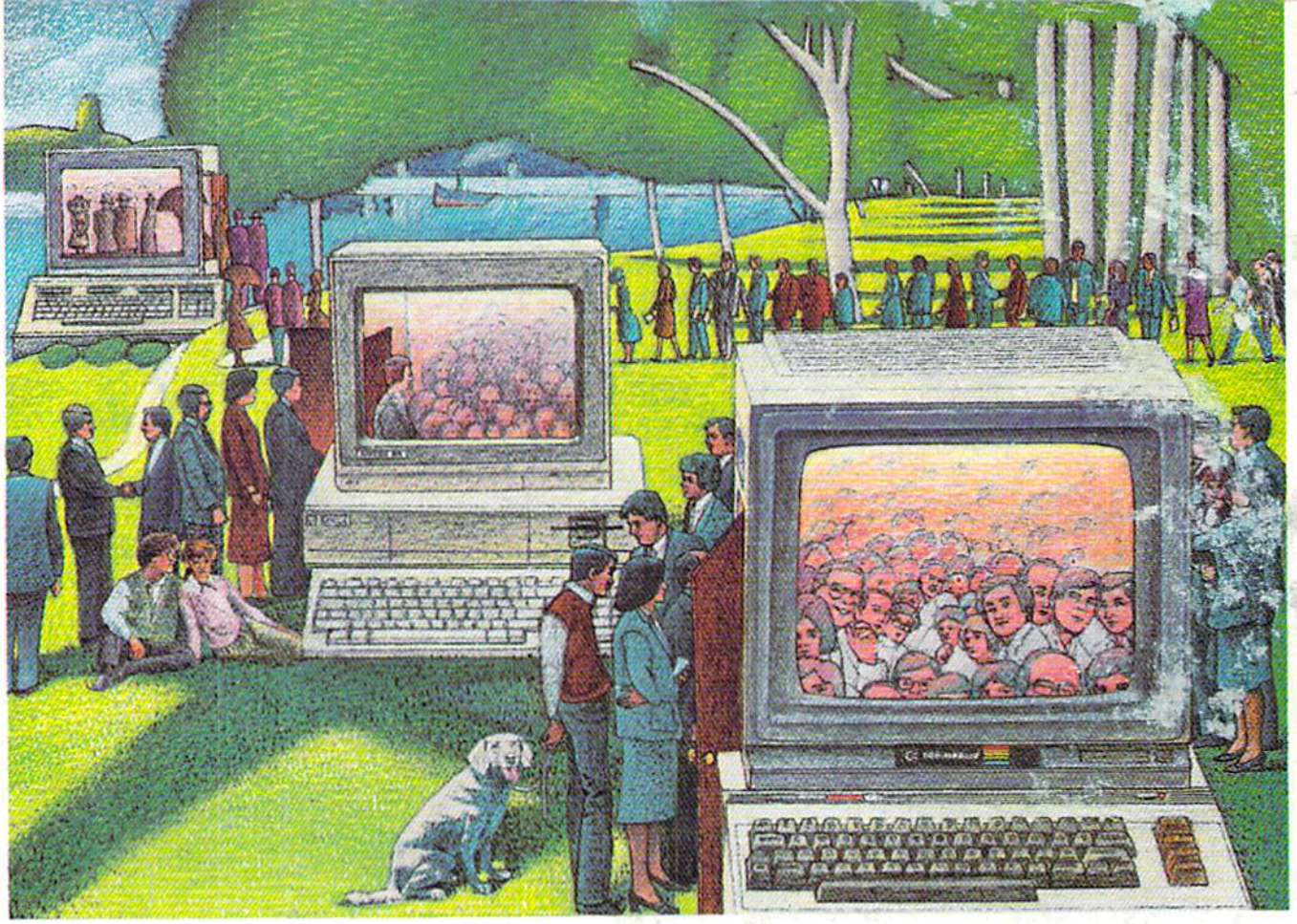

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